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A SKETCH OF NEW ZEALAND,

WITH PEN AND PENCIL.

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LET us turn our attention briefly from the historic lands of Europe and the East, to the wild and beautiful islands in the southern hemisphere. To a mind well stored with the poetry and art of ancient civilizations, such a change will open out new paths for thought amid scenes of rare beauty and grandeur. Of all the islands which, like great emeralds, stud the southern seas, none

have greater natural attractions than New Zealand. As but few Americans have visited those distant shores, we venture to offer the following notes, which we have gleaned not only from the writings of others, but also from personal observations while residing in those islands and from conversation with colonial and aboriginal inhabitants.

Like Van Diemans Land, now changed to Tasmania, New Zealand is unfortunate in its name, as it is in every way in contrast with the Zealand of the Netherlands; while the latter is nearly as level and uniform as the sea, the former possesses some of the wildest and grandest scenery in the world.

We owe the discovery of these islands to the Dutch navigator Tasman, who, in December, 1642, then on his great voyage of

Storehouses.

discovery in the southern hemisphere, came in sight of a bold mountainous land wreathed in clouds, which had never before been seen by Europeans. He relates in the narrative of his voyage that upon sending a boat to this unknown shore, it was furiously attacked by the natives who thronged the beach, and three of his sailors killed. This bloody introduction, together with the knowledge which was soon gained, that the New Zealanders were cannibals, at once stamped that race in the sight of all civilized people as a most fierce and cruel one.

This land was next visited, in 1769, by Captain Cook, who,

during his three voyages to the southern seas, very fully explored and surveyed its coast. Passing through the strait that now bears his name, Capt. Cook showed that New Zealand was composed of two main islands; he also found associated with these a number of smaller and far less important ones. These are now looked upon as forming a distinct archipelago, which is not only isolated from the rest of the world by its geographical position, but in the peculiar character of its native inhabitants, and in the nature of its fauna and flora.

The two main islands extend from the 34° of south latitude 800 miles to the southward, and have an area of about 120,000 square miles, or a little more than the size of Italy. These two countries have, also, a somewhat similar boot-shaped form, the toe in each case being turned towards the equator. These islands are known as the North and South Islands; or in the more poetic language of the aborigines, as *Te Ika a Maui*—the fish of Maui—referring to the form of the North Island; and *Te Wahi Punamu*—the place of the greenstone — indicating the locality that afforded the highly-prized nephrite from which the aborigines shaped their stone implements and personal ornaments. The place of the "punamu" plays as important a part in the history and traditions of the New Zealanders, as did the celebrated red pipe-stone quarry of Minnesota among the red races of America.

Bags made of Phormium leaf, or New Zealand bag.

The North Island is mainly interesting for its lofty volcanic mountains and the indications of volcanic activity still exhibited by the smoking volcanoes, solfataras and hot springs which form the most striking features in its scenery. Among the numerous mountains that record the energy of the ancient volcanic erup-

tions, the most remarkable are Mts. Egmont and Ruapeau; together with the still smoking peak of Tongario. The latter rises near the center of the island to an elevation of 6500 feet, and is the sacred "tapu," mountain of the natives, which no one is allowed to ascend. The trachytic mountain, known as Ruapeau, is the near neighbor of Tongario, and is the highest point in the North Island, its summit being 9165 feet above the sea, and about a thousand feet above the line of perpetual snow. According to the traditions of the Maoris, these mountains once had another neighbor whom they called Taranaki, a quarrel having arisen among them concern-

Maori Woman.

Pihanga, the wife of Tongario, Taranaki was forced to flee to the westward as far as the sea, and now forms the grand Mt. Egmont, whose snowy summit is a beacon to the far off mariner.

Northward of the central volcanic region is the beautiful Lake Topu, about twenty-five miles in length, which is especially interesting for the numerous hot-springs and geysers along its shores, and also for its charming scenery, the grand summits of Tongario and Ruapeau limiting the view to the southward. Between Tongario and White island, in the Bay of Plenty, the only active volcanoes in New Zealand, lies the wonderful "Lake District," that is so widely known for the extent and beauty of its spouting geysers, mud-volcanoes, etc. The heated waters of these springs bring with them large quantities of silica which is deposited around them in a series of beautiful siliceous basins, which are ornamented, as if by fairy art, with the most delicate tints and tracery;

from one to another of these snowy basins flow the clear bluish waters of the fountains. All these indications of the expiring volcanic energy that has been for a long time active, combine to make the Lake District one of the most remarkable places in New Zealand, and equal in interest to the geysers of Iceland, or to the wonderful region of the Yellowstone.

Another area of former volcanic activity, is the peninsula of Auckland, forming the northern extremity of the island. This region is occupied throughout by a great number of volcanic cones, all of which are now extinct and are less remarkable for their size than for their regularity and beauty. Many of these cones of eruption are surrounded from bottom to top with a series of artificial terraces, which, a few years ago, supported palisades and formed the feudal castles of the aborigines.

Maori Man.

The South Island is traversed throughout its whole extent by a great chain of rugged mountains, which were very justly named the Southern Alps. These lofty snow-clad summits give to the South Island a grandeur of scenery peculiarly its own. Midway down the west coast stand the giant peaks of this island; of these Mt. Cook is the highest, and attains an elevation of 13,200 feet. Mt. Cook and its host of sister mountains, all robed in eternal snow, combine to form the grandest mountain scenery in New Zealand, if not in the world. The snow-line is sharply drawn along the sides of these rugged mountains at an elevation of about 8000 feet. Above this height the snows and frozen mists accumulate, and form vast snow-fields which give

rise to the numerous glaciers that flow down from the Southern Alps. The largest of these ice-streams yet explored is the Great Tasman Glacier. This flowing river of solid ice has its source on Mt. Cook and the neighboring peaks, and flows for a distance of eighteen miles down the valley, bearing on its surface an immense load of débris which is slowly carried downwards and at last deposited at the extremity of the glacier as a terminal moraine. This immense glacier ends abruptly in a wall of ice, stretching across the valley one hundred and twenty feet high and nearly two miles in length. Another of the numerous glaciers of the South Island which has attracted considerable attention from the low position it attains before becoming melted by the warm air and winds in the lower portion of the valley, is the Francis Joseph Glacier. This ice-stream flows towards the west coast, and reaches to within about 700 feet of the sea level.

Far below the present glaciers are found the records left by still greater streams of ice, that in times long past descended from the same mountains. Sometimes a hundred miles beyond the terminus of the existing glaciers, an immense wall of glacier-worn boulders and other débris is found, stretching completely across the valley. These huge moraines mark the place where an ancient glacier terminated, and for many centuries deposited, as a terminal moraine, the stones and rubbish that accumulated on the surface of the ice, and were carried slowly forward as lateral and medial moraines.

To the eastward the mountains slope gradually to the ocean, and are bordered by the Plains of Canterbury and other rich areas. On the westward they come boldly down to the sea, and are penetrated by many picturesque sounds and fiords that extend far into the heart of the mountains. Corresponding to the bays and sounds that fringe the west coast, we find to the eastward of the mountains many beautiful lakes which fill deep Alpine valleys and render back the grandeur of the snowy giants that surround them. Lake Wakatipu, which is the largest of these, extends for a distance of seventy miles into the Southern Alps, and seems like a great placid river winding down through the mountains. In the grandeur of its scenery this lake is unsurpassed by the most celebrated lakes of Switzerland or Scandinavia. Lake Wanaka, to the northward of Lake Wakatipu, is pronounced by all travelers who have visited it, to be "the most beautiful lake in all the world."

Since New Zealand was made an English colony, in 1840, great numbers of Europeans have emigrated to her shores. These colonists carried with them the energy and civilization of their native land, and at once became actively engaged in commerce,

New Zealand Forest.

agriculture, mining and other industries. The contrast between the thriving colony of to-day and the luxuriant wilderness described by early travelers is very striking. It almost seems as if some magician had waved his enchanted wand over those distant islands and caused populous and beautiful cities to appear where before only rank ferns grew.

The early voyagers to New Zealand found the land inhabited by an offshoot of the widely scattered Polynesian family. These aborigines still retained the stamp of the brown race from which

they sprang, were of good physique, having regular and often handsome features, and with long dark hair, indicating their superiority to the black races of Africa.

These isolated people were still using implements of stone fashioned into the desired form by chipping and grinding, and frequently finished with a fine polish or covered with fanciful carvings. The material that was often used, not only for stone-axes and war clubs but also for long ear-rings and other personal ornaments, was the celebrated punamu, or green jade from the western shore of the South Island. Many of the stone instruments in the hands of the New Zealanders remind one forcibly of the similar implements used by the Lake-dwellers of Europe, and the stone axes, adzes, etc., from the ancient mounds of our own country Like the Neolithic men of Europe, the New Zealanders had their fish-hooks of bone and their personal ornaments of shell and stone. As is common with uncivilized people, they amused themselves in carving on bone—frequently of slain enemies—and on stone and wood. Many of these elaborate carvings are elegant in design and were beautifully executed with no other instruments than those of stone. Their desire for ornament was so great that they covered their features with tattooing, transferring indelibly to their faces complicated patterns of curved and spiral lines, similar to the designs with which they decorated their canoes and houses.

Maori Nose Flute.

These aborigines were well advanced in all the arts that pertain to barbarous life. They lived in well built houses, usually grouped in villages, or "pahs," and surrounded by strong palisades; these, if well garrisoned, were impregnable until the introduction of fire-arms by the Europeans. The incessant warfare that was carried on between the various tribes was exceedingly fierce and bloody. From the nature of their arms the battles were usually hand-to-hand encounters. The wars were entered into not only from motives of self protection or revenge, but also to obtain slaves and human flesh for the sustenance of the victorious tribe. As may be imagined, such a state of things did much towards keeping the population scanty and the various tribes widely separated.

These aborigines, Maoris, as they termed themselves, were without any form of worship, their nearest approach to a religion being the exaggerated myths and fables of their ancestors. They stand among the very first of uncivilized races, not yielding in personal vigor or bravery to the best of the North American Indians, and unlike them possessing a mind remarkably plastic and capable of improvement and Christian civilization. Such

Lake Wakatipu.

were the people of New Zealand before the pale-faces came among them; since that time their destiny has changed. Although they have abandoned the practice of cannibalism and ceased the fierce wars among themselves, yet they have met a new element in the struggle for existence that is more potent than either. The very presence of the white man seem to affect these children of nature like a deadly malaria. The Maoris, themselves, are aware of their destiny and say, "as the clover killed the fern, and the European dog the Maori dog; as the Maori rat was destroyed by the Pakeha rat, so our people also will be gradually supplanted and exterminated by the Europeans." According to Dieffenbach's calculations the native population of New Zealand was, at one time, about 115,000; in 1872 it had decreased to a little more than 45,000. The natives that remain are every day departing farther and farther from the customs and traditions of their ancestors. Many of the arts that occupied the people in former days are now forgotten; they no longer shape and polish implements of stone, or weave blankets and mats of Phormium. The

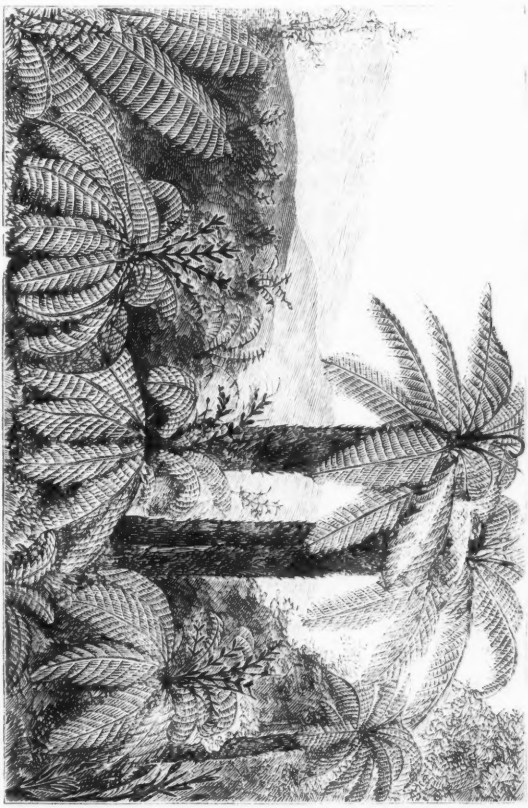
"moco" or tattoo that in former days was characteristic of the people, is now seen only on the older faces; the younger generations having abandoned the custom through the influence of the missionaries.

The Chief's Son.

Not only has New Zealand presented us with a new and extremely interesting picture of man yet in the stone age, but its flora and fauna have been found to be equally instructive.

The traveler who enters for the first time a New Zealand forest, no matter from what land he may have wandered, will find everything new and strange to him. What especially attracts the attention is the great profusion of cryptogamous or flowerless plants, in which these islands are richer than any other country in the world. The ferns alone number about a hundred and twenty species, and form the the most characteristic feature in the landscape. Thousands of these beautiful plants cover the ground with their low and delicate fronds, as in some portions of our own country; others entwine the trunks of trees for support; still others attain the size of forest trees and rear their great crowns of feathery fronds to a height of forty or fifty feet in the air, rivaling in their grace and elegance the date-palm of Arabia. As there are but a few birds of song in New Zealand, and a scarcity of insect life, the woods are always silent. This, together with the strange weird forms of the vegetation around, makes a deep impression on the visitor to whom such scenes are new. Despite the luxuriance of the ferns, we miss the numerous sweet flowers that in our own minds are so closely associated with the deep shade of the forest. In New Zealand the blossoms are, for the most part, small and inconspicuous, and lacking in sweetness.

We would not have our readers conclude, however, that New Zealand is covered by one immense jungle of luxuriant vegetation. Although this is true enough of the regions near the coast, yet in the interior, especially of the South Island, the country assumes a bold and barren appearance, the rounded hills



Tree Ferns of New Zealand.

having scarcely any vegetation except the brownish bunch-grass and clumps of Pteris. Still farther inland the scenery becomes wild and Alpine in the extreme. The cause of this great contrast in the aspect of the country lies not only in the elevation above the sea, but also in the peculiar physical features of the land. The high snow-clad mountains that border the western

shore of the island rob the prevailing westerly winds of their moisture, so that when they sweep on over the land to the eastward, they have but little of this life-giving element to part with.

The fauna of New Zealand, like its flora and scenery, is especially peculiar to itself. The first feature that attracts our attention is the almost total lack of land mammals and reptiles. The former are represented by two species of bats and the latter by a few small lizards. The position filled by the mammalia in other countries is there occupied by the feathered tribes. The birds having been, for a long time, almost the sole dwellers on the island, their development was carried on unchecked and unmodified by many of the circumstances that influence their existence in other countries. This freedom of development resulted in the production of many strange and anomalous forms that were unknown and unlooked for until the studies of the naturalist had confirmed the tales told by sailors and adventurers who had visited those distant shores.

One of the strangest birds in existence is the *Apteryx*, which, as the name signifies, is without wings. This bird is found only in New Zealand, and thus far only four species are known, mostly from the west coast of the South Island. These wingless birds are of great interest, not only from the strangeness of their structure and habits, but also for the information they afford in reference to the giant birds that at no distant day inhabited the same island, but which are now extinct. We refer to the huge Moa, whose bones are scattered over the country, often lying exposed beneath the thick groves of fern, and also occuring plentifully in caves and in recent river deposits. That these extinct birds far surpassed in size and strength any members of the feathered tribes now living, is shown by their ponderous bones which exceed even the bones of horses and oxen in size. Some of the tibias of these birds measured three feet in length, the femur that once articulated with it being between seven and eight inches in least circumference. The largest of these birds, when alive, must have stood at least ten feet high, as is unquestionably shown by some of the complete skeletons which have been mounted. There were surely giants in the days when these monsters strode along in the shadows of the tree-ferns, or tore up the roots of the Pteris with their powerful claws. That the Moa lived in New Zealand after the settlement of those islands by the aboriginal inhabitants is shown by the remains of these birds, which have been found

mingled with the charred bones of men and dogs, in the ancient ovens — "kitchen-middens" — which have been recently discovered. The natives now living know nothing of these strange birds except the existence of their bones in the caves, etc. In their old traditions, however, which have been handed down through many generations, references to the Moa are found, containing instructions to the young hunter how to ensnare and slay them.

In our wonder at the strangeness of these ancient creatures, we must not overlook the many smaller but extremely interesting birds now living in New Zealand. Many of these exhibit a tendency towards the wingless condition that formed such a characteristic feature in the ancient fauna. Among the numerous parrots, one large green species, called by the natives the Kakopo, attracts our attention in this connection, as the muscles of its wings are but poorly developed and useless for flight. The rails also afford two or three species that are incapable of flight. One of these the Wika, or wood-hen, is very common about the swamps and fern thickets. Another is the rare *Notornis*, of which but two individuals are known. The Pukeko is another of the rails that shows by the short, rounded form of its wings a tendency towards the apterous condition. Besides these more curious and interesting birds, New Zealand possesses a considerable variety of smaller and often very beautiful species, few of them, however, of remarkable for the sweetness of their song. Among these the Tui, or "parson bird" is one of the most interesting; its trivial name has reference to the two tufts of white feathers on the throat, which resemble the tie of the parson. The crooked-bill plover, which inhabits the North Island, furnishes the only instance known of a bird with its bill turned to one side; what useful purpose this strange curvature of the bill can serve is unknown.

Since the colonization of New Zealand, a great number of plants and animals have been introduced from other countries; many of these have found in those islands a congenial home, and often seem better adapted to the surrounding conditions than some of the native species, which they are fast displacing. Much of the fauna and flora that is now so characteristic of New Zealand is destined, like the Maoris themselves, to become exterminated by the advance of European civilization.

NOTES ON THE MANUFACTURE OF POTTERY AMONG SAVAGE RACES.[1]

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IN making a critical study of the Indian pottery of Brazil, both ancient and modern, I have been led to investigate some facts in connection with the methods employed in primitive ceramic art, which, up to the present time, have received but little attention.

Some of the more important of the conclusions reached by a study of ceramic ornament have been already briefly sketched in a paper on "Evolution in Ornament" (*Pop. Sc. Monthly*, January, 1875), in which I have attempted to show the origin and function of Decorative Art, and describe some of the more important steps in the growth of these ornamental borders so common on pottery, and known as frets, scrolls and honey-suckle patterns.

The use of pottery is unknown to many savage peoples, as for instance to the Esquimaux, the northern Indians of North America, the Botocudos and Cayapós of Brazil,[2] the Pampean races, the Fuegians, the Veddahs of Ceylon, the Andaman Islanders, the Australians, the Maoris and the Polynesian islanders generally. In some cases this ignorance of the art may be accounted for by the exceedingly low degree of culture of the tribe, as among the Botocudos. In Greenland we should scarcely expect the manufacture of earthenware to flourish, and its absence among the Greenlanders is compatible with a considerable advance in other arts.

Among the Algonkin tribes of Canada and the North-eastern United States, cooking is often done in vessels of bark, either by placing the vessel over the fire or by putting hot stones in the liquid (Relation de la Nouv. France, 1633, p. 4).

I have seen the Micmac Indians of Nova Scotia make square

[1] The following article, published at the office of the *South American Mail*, in Rio Janeiro, in 1875, assumes an intensified interest from the sad death of its author, even before his scientific career can be said to have fully begun. A few introductory and non-relevant sentences, and long quotations are necessarily omitted.—*O. T. M.*

[2] Among the Indians included in the great family of the Cayapós by Dr. Couto de Magalhaes, may be mentioned the Gradahús, the Gurutirés of the Xingú, the Cacahós of the sertœs of Maranhão, and the Cayapós of Matto Grosso.

or oblong vessels of the extremely thin, paper-like bark of the birch (*Betula papyracea* Ait.) and cook in them directly over the fire, just as water may be boiled in a paper cup. The Kutchin tribes of the MacKenzie river have no pottery, but they make kettles of tamarack roots, woven together very tightly and neatly, and ornamented with dyed porcupine quills, in which vessels they boil water with hot stones (Jones Smith's Report, pp. 66, 321).

The Indians of Santa Catalina, in California "brought fresh water to the Spaniards in flaskets made of rushes" (Burney, 2d Voy. of Sebastian Vizcaino, So. Sea Described, p. 248). Similar vessels are still in use in the same region, and Major Powell brought home from the Colorado, water baskets lined inside with pitch. The Maués of the Amazonas use water-tight baskets, and so also do the Kaffirs. Wooden kettles for stone boiling are found among many tribes, both in America and elsewhere, and the inhabitants of Amboyna and Ternate cook in bamboos (Chardin, iv, pp. 171, 172; Receuil des voyages, &c., iii, 322.)

The possession of a material like birch bark may render pottery to a certain extent unnecessary, and thus retard its invention and adoption. The whole subject of cooking in wooden vessels and of stone boiling has been admirably discussed by Tylor. That the inhabitants of the coral islands of the Pacific should be without pottery is not wonderful. It is said, also, that there is no potters' clay in the Sandwich Islands.

Man is not the only animal that makes vessels of clay, but he is the only one that bakes them in the fire to make them durable. Other animals make nests of clay for their young, but primitive man makes earthenware vessels in which to hide away his dead. Man's most primitive vessel was his hand; but leaves, shells, bark, tough skins or shells of fruits, sections of bamboos, &c., were soon used, as by means of these he could not only dip up water, but also transport it from place to place. The same vessels must also have served for the preservation and transportation of articles of food, etc. The art of pottery has, doubtless, originated independently in many different nations, and many circumstances may have led to the employment of clay for the manufacture of vessels. At Unalashka, Capt. Cook (Voy. ii, 510) saw "vessels of a flat stone, with sides of clay not unlike a standing pye." Lyons says (Private Journal, p. 320) that the Esquimaux women have an ingenious method of making lamps and cooking-pots of

flat slabs of stone which they cement together with a composition of seal's blood applied warm, the vessel being held at the same time over the flame of a lamp, which dries the plaster to the hardness of stone, and in a note he adds, that "the cement is composed of seal's blood, of whitish clay and of dog's hair. The natives think that the hair of a female dog would spoil the composition and prevent its sticking." On the Lower Murray the natives line a hole in the ground with clay, and cook their food in it, and sometimes they coat wooden vessels and gourds with clay to prevent their being burned. Both these customs just described might lead to the invention of pottery.

The material of which pottery is made is clay. Ordinary clay consists of fine particles of more or less decomposed feldspar, mixed with a larger or smaller per centage of free silica, which last may exist, either as an impalpable powder, or as a more or less coarse sand.

Kaolinite, used in the manufacture of porcelain, is a silicate of alumina derived from the decomposition of feldspar, containing soda or potash, and it consists mainly of a mixture of silicate of alumina and free silica.

Pure clay will not make pottery, because of its tendency to shrink and crack in drying and baking. It must, therefore, be mixed with some substance to counteract this tendency. In the making of sundried bricks, the Egyptians found it necessary to mix the clay with straw.

In pottery, the substance added is called by the French a *dégraissant*. One of the best materials for this purpose is sand, or powdered silica in some form, especially if the ware is to be burned at a high temperature.

The Danish archæologists have shown that the clay of which the pottery of the Kjœkkenmœddings was made, was mixed with powdered granite, apparently obtained by heating the rock and plunging it into water. In Chiloë to-day, the natives obtain a *dégraissant* for pottery in the same way (Wagner *Chimie Industrielle*. Tom i, 555). In some kinds of earthenware manufactured in England and on the Continent, powdered flint is added to the clay, the flints being prepared by heating them red hot, then throwing them into water, and afterwards pulverizing them (Brogniart, Arts Cer. 1854, i, 71).

Sometimes a cement of pulverized pot-shreds or *terra-cotta* is

added in the manufacture of certain kinds, both among civilized and savage nations. In making, for metallurgical purposes, crucibles that are required to stand great heat and sudden changes of temperature, burnt clay, obtained by powdering old crucibles, is sometimes added to the raw clay to prevent cracking (Foneck. *Zeitschr.* f. Eth. ii. 1870, iv, 290, Ure's Dict. sub Pottery; Brogniart i, 72).

The ancient Indians of Pacoval, on the island of Marajo, used to mingle powdered pottery with the clay for their ware, and in the mass composing the walls of fractured specimens from Sr. Ferreira Penna, I have found quite large fragments still showing their painted surfaces.

In both North and South America, where the Indian pottery is rarely ever thoroughly burned, the clay is often mixed with broken shells. Mica enters frequently into the composition of pottery, and Dr. Berendt has informed me that in Yucatan, even wash gold was occasionally used. Gold is also found in the material composing the pottery of Palembang, in the East Indies (Jour. E. Ind. Archipelago, 1850, iv, 273).

Powdered coke or furnace cinders, graphite, amianthus (Brogniart, l. c. i, 74), and even sawdust are employed in some kinds of modern European pottery, and where a low heat is used in baking, the clay is sometimes mixed with powdered limestone. At a higher heat this latter would serve as a flux.

I am not aware that the Indians of North America ever mixed ashes with the clay, but the custom is very general in South America, where the ashes of the bark of several trees are employed. In Guiana the bark used is that of the Couepi tree, (*Couepia guianensis*) (Ferdinand Fermin, Description générale, &c., de Surinam, i, 61).

On the Amazons the clay intended for the manufacture of pottery is mixed with the ash of the *Caraipé* tree, (*Moquilea utilis* Hooker) (Benth. Martius, Flora Braziliensis, Fasc. xli, Pl. 8, f. 11; Wallace, Travels on the Amazon, &c., 484; Marryatt, "Pottery and Porcelain," 509; Bates, "Naturalist, &c." 225). The Carajás, Caraja-ís, Chambióas, Chavaútes, Chereútes, and Guajajaras of the Araguaya, mix with the clay the ashes of certain *sipós*. I have seen the *Caraipé* bark prepared by stacking the fragments on end in a conical heap, and then burning them in the open air. The ash is very abundant and preserves the original form of the frag-

ments. Having been reduced to powder and sifted, it is thoroughly intermingled with clay, to which, when wet, it gives a dark plumbaginous look, but this color grows much lighter on burning. The use of the *Caraipé*, according to universal testimony, makes the ware better able to stand the fire. The Indians of Sariacu use the ash of a bark called *Apacarama*, perhaps the same as *Caraipé* (Smythe & Lowe, Nar. of a Journ. from Lima to Para. Lond., 1836, 210). The *Caraipé* bark contains an enormous percentage of silica, which separates as a fine white powder. It is to this siliceous powder that the ash, doubtless, owes its value as a *dégraissant*. In the Amazonian region is found a species of fresh-water sponge, called *Cauxi*, containing siliceous spicules, and whose ash is sometimes used to temper clay for pottery (De Souza, Lembrancas, etc. do Amazonas, 101). According to Semper (Der Stil. Band ii, 122) the use of these *dégraissants* and cements, besides destroying the homogeneity of the paste, furnish innumerable points of rest throughout the mass that reduce the fragility of the ware after burning, and the danger of cracking, whether through change of temperature or by shock. The coarser particles serve to break up and distribute the undulations by which the cracks are propagated, very much as a fracture in a pane of glass may be arrested by boring a hole at the extremity of the crack.

By the advent of Europeans, pottery in America was invariably made by hand, the potters wheel being unknown. In the province of Para, among the Indians, and to a considerable extent among the whites, as each family makes its own pottery, stores of this clay are often laid up.

The clay, mixed with *Cariapé*, is kneaded with the hands into a mass, which is then divided into a number of balls about as large as the first. The woman potter then furnishes herself with a board or mat, on which to build up the vessel, some flat object on which to roll out the clay, a vessel of water, and a fragment of a *cuia* or a shell to serve as a smoothing instrument. If the vessel is to have a flat bottom, she presses out upon the board a round flat piece of the required size and thickness. This takes the impress of the board or mat, and fragments of the bottoms of vessels from the ancient site of the "Bluff-Dwellers" at Taparinha, near Santarem, are often beautifully impressed by the mat on which they were formed. Indian women of Santarem sometimes seat

themselves on the ground holding a large ball of clay between the feet. On this the vessel is built up, the ball being afterwards cut off, leaving the bottom flat.

After the bottom is formed, a piece of clay is rolled under the hand into a long rope-like cylinder. This rope is then coiled round the edge of the bottom of the vessel, being flattened sideways by pinching with the fingers of the left hand, and caused to adhere to the bottom. On this, coil after coil is laid in like manner, each being flattened as before.

After a few have been added they are worked into shape with the fingers, which are occasionally moistened in water, and the irregularities produced by the coils are caused to disappear. The vessel is formed by the hand alone, and the surface is smoothed down by means of a bit of gourd or a shell, which is, from time to time, dipped in water. If the vessel be large, it is now set away in the shade for a while to dry a little, after which new coils are added as above, no other instrument being used except the hands and the gourd or shell, with which alone the vessel may receive not only an extremely regular form but also a very smooth surface. According to Dr. de Magalhaes, "the pottery of the Carajás, the Carajáis, Chambioás, Chavántes, Cheréntes, Guajajáras of the Araguáya river is always made by coiling, the surface being worked down by the hand and water, and the aid of a sort of spoon-like trowel made of bamboo." The coils are so worked together that from a simple inspection of the vessel it is impossible to determine how it was built up. I should never have suspected that the pottery of Pacoval had been made by coiling, were it not that I found the coils still ununited on the inner surface of the heads of idols. The coils still preserve the delicate imprints of the fingers of the artist (Am. Naturalist, v. 1871).

In building up a vessel, care must be taken to allow it to harden as the process progresses, so as to avoid its settling by its own weight, as it is very likely to do, especially if the vessel be large. This settling, under the influence of gravity, is, however, likely to give rise to graceful curves, and it would be interesting to determine how far the beauty of outline of pottery may have resulted from the imitation of forms that originated in this way.

Handles and all prominent ornaments are added afterwards, being luted on. Sometimes the outside of the vessel is orna-

mented by applying thin strips of clay laid on in spirals, and other figures as among the Greeks and Romans.

The ancient Bluff-Dwellers were very fond of ornamenting their pottery in this way. The "apple-pie" border, made by impressing with the extremity of the finger, or by pinching up a line of elevations between the thumb and forefinger, was also in common use among the same Indians, and is still perpetuated on the modern pottery of the Amazonas. It was rarely used by the Indians of Pacoval.

In Amazonian pottery, ornaments are rarely impressed or stamped. I have observed on the Bluff-Dwellers' pottery, circles made with the end of a hollow stick. The Chambioás and Carajás of the Araguáya make wooden dies, with which to ornament their pottery, the Carajás using a sort of Maltese cross.

The surface of the vessel, after having been smoothed down, is often washed with a thin layer of pure, creamy clay, which appears to be sometimes burnished before cooking, producing a beautiful, hard and almost polished surface. The common ware of the civilized Indians of the province of Para is usually very plain and rarely ever painted, but that of the Upper Amazon is often most beautifully ornamented in several colors, with frets and borders, and other purely æsthetic forms, the absence of all attempt at representations of plant forms being remarkable. Edwards says that the colors are laid on this Amazon pottery with a brush made of the spine of a palm. The black color is made of the juice of *mandioca*.

The ancient pottery of Pacoval is often adorned with frets and scroll borders and other ornaments, drawn on a white ground with marvelous accuracy (AM. NATURALIST, V., 1871; *Pop. Sc. Monthly*, Jan., 1875).

Ornaments are sometimes scratched with a sharp point on the surface of modern Amazonian pottery, and, occasionally, ornaments are made consisting of a series of holes. The etching on the Pacoval pottery is exceedingly delicate. Sometimes the same pottery is decorated by first washing the surface with white clay, and then engraving so as to leave an ornament in relief. The instrument used seems to have been a tooth of a *paca*, or some other rodent. Some of the large burial vases are covered with ornaments of this kind, which must have required long and patient labor.

Before burning, the vessels are allowed to dry slowly in the shade, and afterwards in the sun. The burning requires much care, and is performed in different ways. Usually, they are set at a distance from the fire, and allowed to become heated gradually, without actual contact with the flame, after which they are surrounded by fire and thoroughly burned. Very often they are covered with a heap of *Caraipé* bark, which is set on fire. Sometimes, on the Amazonas, pottery is burned in an oven or in a hole in the ground. The Carajás and other tribes of the Araguaya burn their pottery in ovens made by hollowing out the nests of the white ant. The ware is introduced, another excavation is made below the fire, and still another in the top of the nest to serve as a chimney. The enormous earthern pans (*yapóna*) on which farina is cooked, and which are sometimes four or five feet across, require to be burned with great care, and their manufacture is usually entrusted only to women of much experience. Ordinarily the pottery of the Amazonas is not thoroughly cooked. That of the Bluff-Dwellers is particularly poor in this respect. While the vessel is still hot after burning, it often receives inside a coating of melted *jutahy-sica* resin, applied with a swab, but I am informed that before the vessel is used on the fire, this is first burned out. This resin is said to be obtained from the *Jutahy* tree of the Amazonas (*Hymenæa courbaril*); but it does not appear to be the product of the *Jutahy* alone.

At Brèves, on the Island of Marajó, there is made a kind of pottery which is first washed with white clay, and after burning, painted in water color in the most gaudy and outrageous fashion. Over this color a varnish of *jutahy-sica*, dissolved in alcohol, is laid. A similar resin, said to be the product of the same species of *Hymenæa*, is used to varnish painted ware among the Maypures on the Orinoco (Humboldt, Pers. Nar. ii, 309). The Abiponian women rubbed their pottery with a kind of glue to make it shine (Dobritzhoffer, Hist. of Abipones, ii, 131). The Indians of Guiana paint their pottery with water color, and varnish it with the gum *simiri* (*Simiri tinctoria*) or *bourgoni* (*Robinia bourgoni*). In Yucatan, Behrendt reports the use of a varnish made from the *Niin* (*Coccus axin* Lallave). The Fijians glaze their ware with a resin, and the ancient Egyptians sometimes painted pottery in distemper and covered it with a resinous varnish ("Pottery, in

Chambers' Encyc.; Williams and Calvert, Fiji, &c., 53; Jenkins' U. S. Expl. Ex., 347; Birch, Anct. Pottery, i, 48, 49; Brogniart, ut supra, i, 502). Von Martius alludes in general terms to the mode of building up an earthen vessel by coiling (Ethno. Amerikas, 712); and the same method appears to have been alluded to by Humboldt (Pers. Nar., ii, 309) when he says that the natives of the Maypures on the Orinoco "purify the clay by repeated washings, form it into cylinders, and mould the largest vessels with the hand."

We meet with the same method again in Chilöe, where it has been described by Dr. Fonck (Die Indier des Südlichen Chile, &c.), who speaks of the vessel as being built up exactly as at Ereré, a flat piece being first made for the bottom, on the periphery of which the wall is formed by coiling up a sausage-like cylinder. He adds that the ware is dried in the smoke before burning (*Zeitsch.* fur Eth., 1870, iv., 290).

Gili describes the process of coiling as found among the Indians of Orinoco, and adds that the surface of the vessel is worked down with a pebble and the fingers, which are, from time to time, dipped into water, the ware being burned in pits with a fire made of bark.

Prof. Charles Rau, the first ethnologist to give due importance to the method of coiling, has, in his admirable essay on Indian Pottery (Smithson. Rep., 1866, 351), translated the description given by Dumont of the manufactury of earthenware by the Indians of Louisiana, in which an account of the building up of a vessel by this method is given (Mem. Historiques sur la Louisiane). Prof. Rau is of the opinion that the building up of pottery by coiling was practiced over a large area in North America. Certainly in South America it was widely known.

Prof. Eggleston, of Columbia College, New York, informs me that in Germany, the large crucibles used in melting are, when broken, built up again with ropes of clay. In this case we have either a survival of an old pre-historic art, or its re-discovery in modern times.

I will now give such information as I have been able to gather concerning the manufactory of pottery by the aboriginal inhabitants of America, for the double purpose of giving a clearer idea of the various processes used, and also of showing that the manufacture is everywhere exclusively in the hands of women.

Molina says (Saggio, &c., Bologna, 1872), that the Chilians have excellent pottery, which they burn in furnaces, or rather holes dug in the sides of the hills, and adds that they apply to their wares a sort of varnish made of a certain mineral earth. Schmidtmeyer (Trav. into Chile, Lond. 1824, 117) says that the present Chileños are good potters for common ware: they introduce a certain quantity of earth or sand, containing an abundance of yellow mica; and jars, holding seventy gallons or more, are made by them of great thinness, lightness and strength, and which sounds as if it were metal. The Pehuenches of Chili, a wandering tribe, made new vessels in every locality in which they establish themselves (Pöppig, Reise in Chile, &c., Leipz., 1835, i, 383).

In Bolivia, the women fabricate the pottery with much superstitious ceremony (D'Orbigny, L'Homme Amer., ii, 150, 233, 339, 363). According to Castelnau, the Chiriguanos women are excellent potters. One vessel measured by him was a metre in diameter and twelve decimetres in height (Exped. vi, 56, 307). Woman's work among the Mojos Indians comprises also the manufacture of earthenware (D'Orbigny, ut supra 233). Gibbon speaks of one Juana Jua Cayuba, a Mojos woman, who superintended the hired women who were engaged in moulding earthen jars (Expl. of the Valley of the Amazonas, p. 246).

The Guarayos women also made pottery, and D'Orbigny speaks of the large vessels in which the dead of the tribe are buried (Frag. d'Une Voy. au Centre de l'Am. Meridionale, 193).

Both the ancient and modern inhabitants of the Andes were famous potters, and the vases of the *Huacas* of Bolivia and Peru have long attracted the attention of ethnologists (von Tschudi y Rivero, Antiq. de Peru; Cat. du Musée de Sevres; D'Orbigny, Atlas d'Antiq. Peruv.; Brogniart, Arts Ceram., i, 525; Ewbank, Life in Brazil). The majority of Peruvian vessels were undoubtedly formed in two or more pieces, in a mould, and afterwards luted together. Some of these molds were made from natural objects, but others bear very elaborate raised figures.

The women of the Indians of Ucayali are represented as being the potters. The Tobas of Mbocobi of the Chaco, manufacture immense *chica* pots like those of the Chiriguanos, the work falling to the lot of the women, as was the case also among the Indians of Itaty, a village of Guaranis, situated at the confluence

of the Paraná and Paraguay (D'Orbigny L'Homme Am., ii, 100; Voyage, &c., i, 199; Brogniart i, 530).

Dobritzhoffer says, "The American women seem to have a natural talent for making various articles. They can mold pots and jugs of various forms of clay, not with the assistance of a turning machine like potters, but with their hands alone. These clay vessels they bake, not in an oven but out of doors, placing sticks around them.

The pottery of the Payaguàs, of Paraguay, was the work of women. Among the Guaycurús, pottery appears to have been woman's work, for Prado tells us that, in this tribe were found men who affect all the manners of women, not only dressing like them but occupying themselves in spinning, weaving, making pots, etc. (Hist., in Revista Trimensal do Inst. Hist. i, 32).

Hans Staden, who was a captive among the Tupinambas, relates that the women of that tribe were the potters. The vessels after having been dried in the air and painted with lines of different colors, were turned upside down on stones, and burned by heaping bark about them and setting it on fire (DeBry, Americae, 3d Part, ii, xiv, 3; See also DeBry, Hist. Nav. in Braziliam, p. 133, 141, 142, 239).

The women of the Arraial do Barro, opposite the Island of Sao Sebastiao are said to have made excellent ware (Art. de Verifier les Dates, 13, p. 110).

The women of the Mongoyós prepared the clay on a banana leaf held upon the knee. It was then placed upon a "plateau" of sifted ashes, and the vessel, after fashioning and polishing, was submitted to the action of fire.

A writer on Brazil (Noticia do Brazil, Lisboa, 1825, iii, 1, 286), says, that the old Tupinambá women made pottery by hand, some of which were big enough to hold a pipe. They also made pots, mugs and pans. This pottery, which was sometimes painted, was burned in a pit, a wood fire being made above. They superstitiously believed that if any one but the person who moulded the pottery were to attempt to burn it, the vessel would break to pieces in the fire.

Spix and Martius (Travels, Lond. 1824. ii, 246) tell us that the Coroádo women provide the requisite earthenware for the family. Pottery is still made by the civilized Indian women in many parts of Brazil south of the Amazonas. Old women make earthenware

by hand in S. Paulo. The clay is mixed by being trodden under the feet of oxen, the vessels being formed by coiling or by molding in several pieces. The clay is sometimes worked into a thin sheet, which is applied to the surface of a wooden mold. The outside is worked down with the wetted hand and the application of a corn cob. After the vessel has dried to the proper consistency, it is cut in two, the mold is removed, and the two pieces are skilfully luted together. Pottery is made in the same way in Bahia.

Except in the olarias, where earthen vessels are made on a large scale, men nowhere in the Amazon region have anything to do with this industry. (On the manufacture of pottery by women in various parts of S. America, see Baena, Ensaio Corographico do Pará, sub voce "Monte Alegre;" Candido Mendez de Almeida, Pinsonia, 1873, 28; Herndon, Explor., 202; Wallace, Travels, 172; Debret, Voyage Pittoresque, Paris, 1834, Catalogue du Musée Ceramique de Sévres; Brogniart, Arts Ceramiques, i, 532; Humboldt, Personal Narrative, i, 196; Gili, Storia Americana, ii, 315; Gumilla, Histoire Naturelle, &c., de l'Orénoque, i, 268; Schomburgk, Hakluyt Soc., Discov. of Guiana by Sir W. Raleigh, 64, note; *id.* Journ. Eth. Soc., Lond., 1848, i, 267; Art de Vérifier les Dates T. 15, 285; Perez, Jeographia de los Estados Unidos de Columbia, i, 485; Bull. Soc. d'Anth. Paris, T.i, Serie i, 1866, 403; Squier, Rare and Original Documents and Relations, p. 46; Bibliotheca de Autores Españoles, Historiadores primitivos de los Indias, i, 348).

Dr. Berendt writes from Yucatan that "certain classes of pottery, manufactured in some towns of the interior, are not only carried all over the country, but exported to other parts of Mexico, and even to Havana; among them are unglazed basins for cooling drinking water, also large and small water-jars, some preserving the ancient Yucatan forms, others imitating foreign models. These are made by men, mestizoes, and mostly by hand, on the turning wheel. In some places far away in the interior, or without any connection with the larger centers of trade, as also in Peten, the proceeding is still more primitive, and is exclusively in the hands of women. They search for the clay, load it on the backs of children, and work it on the *metate* before fashioning it with the hands. Large jars they generally form from two pieces. I have not seen that they mix their clay with ashes;

but they often mix different kinds of clay together. The class of pottery used by the poorer classes comprises the *comal*, (flat plates to bake tortillas on), *cajetes*, or small plates (saucers) for certain dishes, etc. No kind of glazing is used for this kind of pottery, but in its place a varnish is sometimes used, made from *Viin* (*Coccus Axin* Lallave), and this is occasionally painted. It is an ancient proceeding. I possess a vase, dug out at Jaina on the Gulf Coast north of Campeche, whose varnished and painted outer surface imitates admirably the design of ash wood. The pottery of the ancient Mayas shows great variety in form and in structure. Clay of different colors (dark red, light slate color, light and dark red, and brown) is sometimes mixed with mica or shell-gravel, and other substances, such as, in other parts, even wash gold. The ornamentation consists of figures and arabesques sunk or scratched into the surfaces, or elevated into reliefs and often painted. The modern pottery of the Indians is generally plain. The ancient pottery found in the interior, and particularly near the gulf-coast of Yucatan, shows a much higher art than that from the east coast, Cozumel island, etc."

Pottery making fell to the lot of the Carib women, and according to Ligon they manufactured a very handsome light ware (De la Borde, "Relations de l'origine, &c., des Caraibes, &c., Receuil de divers Voyages, p. 23; McCulloh, Researches concerning the Aboriginal History of America, p. 84).

Mr. Squier describes the pottery of Nicaragua as painted and glazed (Nicaragua, i, 287). The ceramic artists among the Indians of Fort Yuma, California, are women, and the same is the case with the Zuñis, whose beautifully painted pottery closely resembles that of the ancient Indians of Pacoval (Michler, Rep. U. S. & Mex. Boundary Survey, i, 101; Pac. R. R. Rep., iii, 50). DuPratz says that the Indian women not only "make the pottery but they dig up and mix the clay" (Hist. of Louisiana, Lond., 1774, 360).

Adair informs us that the Cherokees glaze their ware, and make it very black and firm by placing it in the smoke of a pitch pine fire (Hist. of Am. Indians, Lond. 1775, 4).

Hariot says of the natives of Virginia: "Their women know how to make earthen vessels with special cunninge, and that so large and fine that our potters with thoye wheels can make noe better" (DeBry, A brief Report, &c., 1590; Campbell, Hist. of

Virginia, 28; The True Travels, &c., of John Smith, p. 131; Strachey, The Hist. of Trav. into Virginia Britannica, p. 112). On the Georgia Indians see Bartram, Travels, Lond., 1792, 511; On the Iroquois, Schoolcraft, iii, 81, and Notes on the Iroquois in Squier & Davis, 223; On the Hurons, Parkman's "Jesuits in America," p. xxx.

An account of the pottery manufactured among the Indians west of the Mississippi river is quoted from Hunter's "Manners and Customs of several Indian tribes west of the Mississippi" in Prof. Rau's article on Indian pottery in the Smithsonian Report, 1866, p. 351.

Among the Mandans, women were, as elsewhere, the makers of earthenware (Catlin, Manners and Customs, Letter 16).

Among the Micmac Indians of Acadia, the birch-bark vessels in which cooking is performed, are made by the women, and we have already seen how she prepares, among the Esquimaux, the stone lamps and cooking vessels.

Jewett thinks that the Celtic funerary urns were formed "most probably, judging from the delicacy of the touch, and from the impress of the fingers which occasionally remain, by the females of the tribes" (Grave Mounds and their contents, 83–85).

At Ordezan, near Bagnière de Bigorre, pottery similar to that found in caves is still manufactured by women. Tylor speaks of a set of hand-made pottery found in use by an old woman in the Hebrides.

The Kaffir women not only cook, but they make the pots they use, the clay for the purpose being obtained from ant-hills. They also make baskets that will hold milk or beer (Wood's Unciv. Races, 77, 143; Campbell, Travels in So. Africa, 523).

Burton says, concerning the manufacture of earthenware in Eastern Africa, "The figuline, a grayish brown clay, is procured from river beds, or is dug up in the country; it is subjected to the preliminary operation of pounding, rubbing dry on a stone, pulverizing and purifying from stones and pebbles. It is then worked into a thick mass with water, and the potter fashions it with the hand, first shaping the mouth; he adds an inch to it when dry, hardens it in the sun, makes another addition, and thus proceeds until it is finished. Lines and other ornaments having been traced, the pots are baked in piles of seven or eight, by burning grass. Usually the color becomes lamp-black. In Usagara, how-

ever, the potters' clay burns red like the soil. A cunning workman will make in a day four of these pots, some of them containing several gallons, and their perfect regularity of form, and often their picturesqueness of shape, surprise the stranger. The best are made in Ujiji, Karagwah and Ugunda, those of Unyamwezi are inferior, and the clay of Zanzibar is of all the worst."

Schweinfurth states that "as in the case with the majority of the inhabitants of Africa, the manufacture of pottery is practiced by the women (*Zeitschrift* fur Ethn., 1873, i, 8).

"In Yoruba," says Bowen, "the women make earthern pots" (Central Africa, p. 308); and so, also, do those of Garo-a-Bautschi and Tesan, and the Guinea coast. We are, therefore, I think, justified in coming to the conclusion that the fictile art, in its infancy, is confined to the women is as true of Africa as of America.

In the East Indian Archipelago, the Papuan women make pottery (Journ. of Ind. Arch., v, 313; Norris' Ethnogr. Lib., i; Earl's Papuans, p. 73). While pottery is unknown in the greater number of the South Sea Islands, in Fiji it has reached a high state of development (Williams and Calvert. Fiji, N. Y., 1859, 53; Wood, Unciv. R., Amer. Ed., 930). Women have the making of pottery entirely in their own hands, and the art, moreover, seems to be confined to the women of sailors and fishermen. It is also worth noting that the Fiji women are skilled in the manufacture of stamped bark cloth, making the patterns themselves (see also Jenkin's U. S. Expl. Exp., 341, 347; Lubbock, Preh. Times, 443; Pickering's Races of Men, 163).

The facts I have given seem to show that among savage tribes generally, the fictile art is, at first, exclusively practiced by women, the reason being that, primarily and essentially, the fabrication of earthenware is a branch of culinary work, which last, everywhere falls to the lot of the gentler sex. Man, among savages, is the hunter, fisher and warrior, while the woman takes care of the house, and of the culture of the field. When, however, in the progress of the tribe in culture, the practice of the art of pottery comes to be a profession, and to interfere with household work, it passes naturally into the hands of man, and it will be found that in every case where men make earthenware the tribe has advanced considerably beyond the savage state.

But savage woman not only fabricates vessels of clay, she also

ornaments them, and if the fictile art has originated with her, and has grown up under her hands, it seems no less probable that the ornaments she uses should have originated with her, and the probability is increased by the fact that to her falls the work of spinning and weaving, of making and decorating personal ornaments and clothes, and of making baskets, mats, etc. She is everywhere the primitive decorative artist, and to-day it is the exception that man occupies himself with ornamental art, even in civilized countries. Woman covers with ornament everything her hand touches, and the lady in her boudoir industriously embroiders, on some article of mere luxury, the same series of frets and scroll borders that, on the Amazonas, the savage unclothed squaw as diligently and with as firm a hand, traces with a spine on the damp surface of the clay vessel she is fashioning. It is as if they both sang the same simple song. The ornaments in both cases are identical and not only of wholly independent origin, but it may be also of very different age. Those of the savage are the mere embryonic beginnings of art-life, while those of the boudoir, like the *Lingulæ* of to-day, are archaic forms, persistent through the ages, still flourishing unchanged among the varied wealth of derivatives by evolution from the ancient primary forms.

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SEEDS OF THE VIOLET AND OTHER PLANTS AS PROJECTILES.

BY MOSES N. ELROD, M.D.

THE capsules of the cleistogenous flowers of *Viola cucullata*, *V. canadensis* and *V. striata*, by a peculiar mechanical movement of the valves project their seeds from a few inches to four or five feet. As *V. cucullata* is a very common plant, with numerous seed pods in the latter part of the season, it has been most carefully studied, and will be the first described. When the seeds are ripe, the pod that before had been folded back on its crooked procumbent stem, becomes erect, opens into three valves that place themselves at right angles with the straightened and erected peduncle, and, as it were, look directly upwards. By straightening the peduncle, the seed vessels that heretofore had been concealed, are brought on a level with or above the leaves. Each one of the carinate valves contains from three to four rows of

seeds, attached by short funiculi to a common parietal placenta. The seeds of the inner rows being attached to the top, while the outer ones are attached to the sides of the raised keel, give to the boat-shaped valves an appearance of overloading, and are heaped up in the middle, and were it not for their slender funiculi would be spilled out by the least motion. The shooting process is now begun by the hard smooth edges and sides of the valves pressing on the outer rows of seeds below their greatest diameter; the pressure being transmitted to the under side of the seeds of the heaped up middle rows, they generally are the first projected. Usually but one seed is projected at a time, and the short funiculi permitting another one to take the vacant space, the inner rows are kept full until but a single row remains. But the movement does not stop here; it is continued, and the pressure reinforced by the outer, and sometimes the inner end of the valve coming into close contact and clasping the seed on three sides, until all are forced out, one by one, and the sides of the valve are left in contact. During the process of drying, which still continues in the now empty and useless valve, the sides are separated and it again assumes the former carinate shape. Any one seeing the dry and empty pods would scarcely think of their having gone through the changes we have described. And as the movements that project the seeds take place while the valves of the capsule are yet in a semi-green state we conclude they form an important part in the life history of the plant. The pods of the inconspicuous flowers of *V. striata*, are grown in the axils of the leafy stem, on long peduncles, and have the same movements of straightening and erection as in *V. cucullata*. The pods of *Viola canadensis* are sessile.

The projecting movement may be roughly compared to the unlading of a boat by slowly crushing the sides together.

The shooting process may be conveniently watched by gathering the mature pods after they have opened, and plunging the stem into a cup of sand; however, treated thus the valves after once closing will not again re-open. The lateness in the season at which my observations began, prevented my seeing the pods following the conspicuous flowers.

In giving the generic characters of *Pilea* in his Manual of Botany, Prof. Gray says, "Fertile flowers. Sepals three, oblong, more or less unequal; a rudiment of a stamen before each in the

form of a hooded scale. Achenium ovate, compressed, straight and erect, partly or nearly naked."

In *P. pumila* the distal end of the elastic hooded scales are held down by the otherwise naked seed. The rudimentary stamens may be compared to a V-shaped spring, the ends of which are pressed together. When the seed is ripe and its connection with the receptacle broken, the hooded scales suddenly, partially straightens and the seed shot into the air five feet or more. The arrow-head shape of the achenium, and the arrangement of the cymes on long axillary stems shortened from below upwards, are favorable to the great range of the flying projectile. The mechanism of the movement is sufficiently simple, but the special adaptation of an essential organ of a perfect flower to a new use is very peculiar.

Prof. Gray says of *Oxalis*: "Pod membranaceous, deeply five lobed, five celled, each cell opening on the back. Seeds few in each cell, pendulous from the axis, their outer coat loose and separating." The loose outer coat of the seed of *Oxalis stricta* bursts on the edge opposite its attachment to the axis, and is suddenly rolled back, breaking the funiculus, and at the same time separating the walls of the cell and projecting the seed two or three feet. By this movement the loose coat is generally turned inside out. The flattened oval seeds are marked on their sides by transverse striæ that doubtless give direction to the elastic coat when it bursts. Before the seeds are fully matured they may be removed from the cell and the coating caused to burst by touching them with some sharp-pointed instrument. So quick is the movement that one is strongly reminded by it of a jumping flea. No other species than *Oxalis stricta* was observed.

That the movements of the seeds described are important, if not essential to the life of the plant, seems evident. The ripening capsules of the violet may be found until late in autumn, we have seen them after snowfall, and without some such movement as has been mentioned, would go on seeding the same ground the season through, and year after year. The same remark is true of the wood sorrell, the membranaceous pod of which would otherwise fall to the ground near the root of the plant carrying its crop of seeds with it. The general resemblance in habit and appearance of balsam and richweed would lead us to expect some special provision for scattering their seeds in the one as the other.

It may be further noticed that while the movements described are each different and peculiar to a single genus of plants, they are unlike those of the well-known balsam, and those of the witch-hazel as given by Mr. Meehan a few years since.

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INSTINCT AND REASON.

BY F. C. CLARK, M.D.

IF the great array of startling facts, presented in the works of Mr. Darwin, be not wholly convincing, they at least clearly demonstrate a somewhat closer connection of man with lower organizations than has hitherto been acknowledged. Since the invention of the microscope and its application to the natural sciences, the study of natural phenomena has opened a field of inquiry never before dreamed of by the most imaginative theorist. Myriads of infinitesimal forms of life, which formerly escaped detection, have thus been revealed, and though many a one lacks that complexity of organization which usually attracts our notice, yet even in their simplicity they present a problem as intricate and perplexing as the most highly organized being. These minute organisms often seem but mere centers of life (points of attraction), around which cluster other existences still more minute and but just perceptible to the highest powers of the microscope. Organization appears, many times, hardly more than nominal. Even to-day their nature defies solution, so as to render it impossible to assign them any satisfactory place in the scale of being; and after the new discoveries daily added, the naturalist is at a loss to find the dividing line between the various forms of life expressed by the old names of "animal" and "vegetable."

The division of the living world into the "vegetable" and "animal" is at best but arbitrary. It is not enough to take well characterized types of each division and compare them with each other. Such differences would be self evident. But, instead, it is needful to give such a definition of each division as will cover every variety, however diverse, which is included in that division to which the definition has been given. Thus, much confusion in classification is avoided; though, unfortunately for us, the problem remains unsolved; for the new facts daily brought to light render necessary continual changes in classification, and

broader definitions. In the present state of natural science the best classifications cannot be otherwise than approximate and unsettled. But the link between unorganized and organized matter has thus far defied discovery. Whether the different expressions of existence are due to that inherent change exhibited by all matter—that change in which all natural phenomena consists, resulting in a spontaneous generation, the necessary elements or factors being present; or whether to a special creation to satisfy each individual case, as a species; these are questions still under dispute, whose explanations have their different disciples.

Passing by that which makes up the organization of all living beings—the mineral—it is designed in the following pages to discuss the manner in which the different vital forms express their existence under their different phenomena, dependent of course upon their individual organizations. Hence organization determines the character of the individual as well as of a species or family. But it should be here stated that it is not intended to discuss the province of a species. This is for the specialist.

Again, we are to observe how each organized being supplies its wants and the means or organs for supplying them. In every form of life, however high or however low in the scale of being, there must necessarily be some way in which each form maintains its existence. It is not to be expected that all vital beings, irrespective of their organization, demand the same mode of supply, but some means of supply. Each after its own kind must so dispose of the elements of nutrition about itself as best suits its organization. Each one, therefore, will take from the alimentary substances it receives only that best suited for it, or is refused, or avoided by other higher or lower forms. In this way that constant change of elements is effected by which all life is supported; by which the structure of one is fitted for a higher form of life; and the detritus of a higher prepared for a simpler and more lowly being. Thus does the vegetable supply the animal with food, and in turn the animal adds to the growth and vigor of the plant. The luscious fruits of the garden, which form a part of the delights of life, contain the same elementary principles found in man, but there taken at second hand. The vegetable being a builder up of tissue can exist where the animal would become extinct, for it is the tendency of all animals to destroy combinations and to form compound products.

Now, for these various forms of life to effect these important and complicated results, there must needs be some power behind all capable of directing the phenomena manifested in each individual. The selection of the required food, the choice of a habitat, and the end of all—the ultimate propagation of its kind—are by no means mechanical phenomena.

The general opinion has hitherto been, that man was guided by intelligence or reason, and the lower animals, without exception, by instinct, differing most essentially from reason in that it was innate. Gradually, however, many of the actions of the lower animals, as well as some of man which were regarded as instinctive, were acknowledged to be intelligent. These actions were supposed to be the same in kind, but different in degree. A step was thus made in advance; and what could not be longer denied forced itself upon the attention of all.

It is a matter of peculiar difficulty to draw a line of distinction between instinct and reason. The best thinkers, among whom may be cited Herbert Spencer, consider that no *hiatus* exists between the two, but that the one passes into the other by insensible degrees.

Simple reflex action, sometimes called "reflex action of the spinal cord," is wholly unconscious action. It is the action of muscles seen in decapitated frogs, and in acephalous children (monsters) who, in their short life, perform simple acts as readily as babes with brain intact. Herbert Spencer supposes the simplest acts to be unconscious, performed by the animal automatically, in its endeavor to get rid of offending matters. And this acquired power is inherited and becomes then instinct, or complex reflex action of another sort.[1] Instinct is the inheritance of accumulated experience; is also a lower grade of intelligence, into the highest of which it gradually develops. The dog after having been taught the trick of "begging" will transmit that faculty to its offspring, which will be used as occasion requires.[2] Mr. Lewes and Mr. Spencer appear to agree in regarding instinct as being lower than reason. Acts which were once voluntary and intelligent may become involuntary and habitual, then instinctive. And as acts became more complex they become less frequent, and more subject to the control of the will. Hence instinct is "lapsed intelligence," so to speak.

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The theory of evolution aids us greatly in explaining many of the phenomena observed in the lower forms of life, perfectly inexplicable by any other mode of inquiry. From the simple and hardly exertive act of the monad to the complex and manifold actions of man, we cannot fail to perceive a constant progressive development, undeniable and indisputable. Each separate principle, if separate and distinct it be, overlaps another, there being no chasm, no break to evince the beginning of one and the ending of the other. The simple reflex act becomes compound; phenomena cease to be involuntary, and become conscious and intelligent.[1]

First Forms of Life.—In regard to those transitional forms of life whose place in nature has not yet been determined, which multiply like the individual cells which make up animal and vegetable structures—by fissuration—little can be said respecting

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It may be further noticed that while the movements described are each different and peculiar to a single genus of plants, they are unlike those of the well-known balsam, and those of the witch-hazel as given by Mr. Meehan a few years since.

INSTINCT AND REASON.

BY F. C. CLARK, M.D.

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either their instinct or reason. But that one or both these principles must be present, can be best seen from their analogy to higher forms.[1] But if, as Herbert Spencer teaches, instinct is but compound reflex action, and if in these lowly beings we observe simple reflex action to predominate over compound, it is but a step to invest even these transitional forms with some degree of instinct. And again following the same author, we cannot fail to see, from analogy at least, some degree of reason, however slight.

It is seemingly so immaterial to this class of beings as to their place of abode, and so easily and rapidly do they reproduce their kind, that it is not surprising that the theory of spontaneous generation should have received so much attention and gained so many partisans. Still, in what light soever they are viewed, they must be allowed the requisite elements of growth and function; for without these they must as truly perish as the higher forms of life when they, too, are deprived of proper function and nutrition.

Whether regarded as animal or as vegetable, these lowly forms must be conceded some skill, however slight, for obtaining wants and for protection against enemies. Few, if any, of the higher forms of life are unprovided in this respect. Thorns render plants less liable to injury. The cuttle-fish stains the water in the track of its enemies of an inky blackness, and thus escapes. The spider simulates death; and so does many a crustacean. The polyp can be severed into hundreds of fragments, but it revenges itself by reproducing as many new individuals; and the mollusc is protected from foes by a hard closed shell.

Our knowledge of the lowest of the protozoans is but scanty, yet they all have means for engaging successfully in the struggle for existence. Each protozoan, or other, must put forth efforts proportioned to its development, to be met and overcome by still higher development. Something is displayed in the contest of offence and defence which seems like intelligence, but more akin to instinct. Their actions observed here are so nearly related to reflex action alone, that the problem of separating instinct from pure reason is at present utterly impossible. But yet where observation fails analogy will perhaps succeed.

Now if, for example, we touch with the point of a fine needle

[1] Vid. Pop. Sci. Monthly, Dec. 1873, p. 180.

one of those beautiful bell animalcules, named Vorticella, it instantly darts backward as though attached to a tense elastic thread. If we observe it more carefully we perceive the stem of the bell flower to be gathered into several spirals like a helix. After a while the animalcule recovers from its fear and extends itself, spiral after spiral being shaken out. If the vessel in which they are contained be jarred even, they dart quickly backward as if touched. After a short time they get accustomed to jars and the like, and a considerable shock is required to cause them to withdraw into the depths of the vessel. Now here at least, some impression, strong enough to affect them greatly, is made upon these little bell-flower animalcules. If instinct be advanced to explain this phenomenon, then the onus of proof, as to where instinct ends and reason begins, belongs to the one who advances that idea; if reason, however small, then we must allow the consciousness of action to obtain in all the processes of nature.

Every form of life, then, whether animal or vegetable, does but furnish different modes of expressing life. What is lacking in one is made good by approximation, so far as it is consistent with the needs and demands of that organism. The plant has no brain, no blood circulation; but the sap of the plant is pumped up by the rootlets throughout every part; and the circulation here is as perfectly established as in the animal, though in a different manner. For their purposes in life, then, these transitional beings need no complexity of nervous system, roots and sap. They would have no call for them in so simple an organization as they possess.

Plant Life.—A plant, as we understand it, is a cellular organism, consisting of a part below ground called the roots, and a part above denominated stem, branches and leaves. Parasitic plants have properly no roots, but, as their name implies, subsist upon higher vegetable forms. Air plants, fungi and lichens also belong to our category of plants, although differing so widely from our type.

Plants, being for the most part limited in motion, shoot out roots in all directions beneath the ground in search of elements of nutrition, rear a stem aloft, push out branches and put forth leaves to catch the sunbeams, by means of which they decompose the atmosphere to obtain the proper requisites for the life, respiration, growth and vigor of that form of life. The plant never

fails to direct its stem, branches and leaves towards the sun; and in our typal plant, roots never fail to be thrust downward into the earth, in what form soever it may be placed in the ground. Leaves often change to roots, and roots in favorable circumstances become leaves. The greater the spread of foliage the more vigorous and, consequently, the healthier will be the condition of the plant. At this point it may be well to note a universal law or principle: the more sunshine and air (of course at some time reaching a limit) the more abundant the foliage, and the denser the foliage the stronger and more flourishing the plant. This may be proved by comparing out-door plants with badly managed in-door and hot-house vegetation. Plenty of sunshine and air soon show a marked change for the better.

Illustrating the subject by means of our type, we find the organs of a plant to be roots, leaves and the modifications of the leaves for reproductive purposes. The stem, or trunk, is but a canal, altering in size to suit the varying conditions of the plant, and is used for purposes of alimentation and the circulation of vegetable products between the roots and the leaves. The growth of the stem depends upon the same law which governs the growth of the roots and the branches upon which the leaves are supported. In a word, the stem seems to act as a support for the leaves. Growth itself depends upon the proper assimilation of the elements of nutrition derived from the chemical changes occurring in the roots and leaves, and to some extent in the stem.

Marine and fresh water algæ, if deprived of roots, have in their remaining organs all the functions necessary for their peculiar mode of existence.

The structure of a plant is cellular, showing its origin to be from the segmentation and accumulation of cells, one upon the other. The microscope shows how beautiful is the plant tissue, and how different in different varieties, but in every one this distinct cellular formation is apparent.

The plant is also possessed of the means for assisting its growth, as runners, creepers, tendrils and the like. For reproductive purposes it has nettles, thorns, elastic fibres, as in the seed vessels of the squirting cucumber (*Momordica elaterium*); but above all in its essential organs of reproduction—its flowers containing the stamens and pollen, ovary and pistil. The first

class of propagating agents are secondary or non-essential, the latter the essential organs. The former passive agents, the latter active.

Thorns, briers, nettles, etc., are also passive elements of defence. For offence many plants have a singular apparatus, especially that curious class of plants termed insectivorous, or carnivorous, hereafter to be discussed.

But the plant demands food. This it obtains in a peculiar way. Its anatomy and physiology are adapted to that peculiar way. It does nothing contrary to nature with impunity. Mode of growth in all plants tend to the same end. Hence the lowest as well as the highest can do no more than supply wants; seek a situation best suited to its growth and development; remove or avoid obstacles interfering with growth, and reproduce its kind in due time. For this purpose certain organs are exercised, and this constitutes the functions of a plant.

In plants, as well as in animals, we everywhere perceive the operation of the law which secures to them what naturalists term "the survival of the fittest." The weaker must succumb to the stronger, and disappears, is annihilated, when the struggle for existence becomes too great for that form of plant life.

Plants which need much air (or elements of air) and light, and moisture, are found in situations most favorable for obtaining them; if deprived of them the result is obvious.

In the case of most terrestrial plants, a suitable depth and character of soil are required. If the soil be too poor in the elements of nutrition required by a peculiar kind of plant, or in excess, or the soil too dry or too light, the different elements must be duly supplied or apportioned, and sufficient moisture furnished by irrigation lest the heat of the sun destroys the roots of the plant. The same principles are observed in respect to all the classes of the flora spread over the earth. Warmth implies light or sunshine, and where it is wanting none but the lowest orders, like the lichens and algæ, survive. The different climates also possess their own vegetation, and even in different regions of the same zone we find plants totally distinct from each other. Hence circumstances, as well as conditions, must find a place among the demands of a plant.

For the removal of obstacles the plant has two courses, to disintegrate the object opposed to its progress, absorbing it if it be

a suitable nutritive element, as are all animal and vegetable substances and some minerals; or pass around it; or still again, as in extreme cases, to bury it up in its own substance, as are stones, bayonets, nails and the like.

For its protection, defence and reproduction the plant has at hand sufficient means. Some of the many devices for these purposes have already been noticed. The manner of plant reproduction is familiar to all; the object being in all cases the contact between pollen and ovary or seed vessel. In this way the propagation of most plants is effected. In regard to the flowerless or cryptogamous flora, spores, it will be found, take the place of seeds proper. Yet for all that, the principle of reproduction remains the same in both divisions.

Such, then, are the organs, functions and factors exercised in the life of a plant. It now remains for us to consider how these are put into action according to the means at hand, pursuing as the plant does, many times, a most reasonable course, and acting in a manner so peculiar as to excite our wonder and admiration. We must first remember, however, that we have to do with a form of life whose phenomena have been but little studied, for it was not till late in the period of the *Renaissance* that botany became a a separate science, and that plants had a natural classication of their own.[1]

Plants are susceptible of improvement, which is well shown by cultivation. Thus flowers take upon themselves a great variety of forms and colors, and sometimes to so great an extent as almost to deserve to be classed as new and distinct species. But yet there is sufficient likeness between them, some characteristics traceable to the original stock; or some peculiarities due to inheritance; some similitude to the parent to make them belong to the same species. Darwin considers all the different species, or varieties of pansy to be derived from one parent, as may be said in reference to the pigeon and the dog kind.

Trees often adapt themselves, in a remarkable degree, to the surrounding circumstances. Thus the feral oak, growing as it does in the midst of other trees, which oftentimes are densely crowded together, sends out branches at a more acute angle than does the meadow or cultivated oak. Much difficulty is experienced in cultivating the feral variety, so as to give it the grace and

[1] First Nat. Sys. Bernard de Jussieu, 1759; Figuier Vegetable World.

beauty of the meadow oak. Other trees, like the walnut and chestnut, present the same peculiarities.

Plants appear to possess sensibility, and often to a remarkable extent. If the well-known sensitive plant be touched never so lightly, if but a breath blow upon it, its flowers and leaves close; and some time elapses ere it dares to expand them again, as if it knew the danger threatening it. If only a sister leaf be touched the rest close as if out of sympathy.[1]

Drugs exert their peculiar influence upon plants as upon the higher animals. Spirits of ammonia, if applied too strong, will be fatal; opium puts the plant as effectually to sleep as it does man; prussic acid is also destructive; electricity exerts here its peculiar and wonderful effect.[2]

In plants, as in animals, we sometimes observe what is termed "suspended animation." This phenomenon is well instanced in the "resurrection plant," generally known as the Rose of Jericho. It is found in Arabia, near the shores of the sea, to all appearances a mass of dry, dead vegetable fibre. But when sufficient moisture is supplied, it revives, its leaves expand, it is clothed in new verdure, and as it blossoms unfold, the reanimated plant is clothed in all its former beauty. No wonder is it that the Rose of Jericho should be almost adored by the simple people among whom it is found.[3]

The Sleep of Plants.—When night approaches, flowers close their petals, and thus at rest, only wake when the sun once more ushers in the day. DeCandolle, as did Linnæus before him, made many experiments with plants in this particular. At night, plants were exposed to a bright light, and during the day were placed in a darkened room. After some irregularities, the change of conditions was finally adopted by the plants, and in the lighted room they would blossom, and close their petals and leaves in the darkened one.

Some plants, however, only flower at night. The beautiful Yuccas, a species of wild lily, only blossom when the moon is out. The night blooming cereus only blooms as its name indicates. Hence the time, as well as the season and the climate, etc., seem to be elements of importance in the flowering of plants. These conditions may be slightly varied, as seen above.

[1] Vid. "Wonders of Vegetable World." Scherl De Vere.
[2] Ibid.
[3] Ibid.

The Movements of Plants.—Slow motion is obvious in all plants, as in their growth, and in their tendrils, creepers, etc. But the most rapid and continuous motion probably possessed by plants, is exhibited in the *Desmodium gyrans*, of India. Each leaf of this plant consists of three parts, two external and small leaflets, and one central and large leaflet. The external leaflets move up and down in alternate jerks, at the rate of sixty a minute. The central one moves but little. This motion is continued during all the seasons of the year, and during the whole lifetime of the plant. Warmth and moisture, however, expedites the motion.[1]

The Offensive Weapons of Plants.—The first of these offensive plants is the familiar Venus's fly-trap (*Dionæa muscipula*) which sets its traps, and woe betide the unwary insect which ventures near the the hidden toils, allured by its attractive appearances. The springs are all set, the prison prepared and sure destruction awaits the victim.

The *Darlingtonia californica* belongs to the pitcher plant family. Its appearance has been likened to a cobra in the act of striking. The beautiful "red wattles" within the brim of its pitcher offer irresistible attractions to insects, especially to flies. These alight first upon the "wattles," then flying upward strike the pitcher, and owing to the peculiar twist of its walls fall to the bottom of the receptacle, where many another thoughtless fly has, too late, found its sepulchre.[2]

Dr. Erasmus Darwin,[3] grandfather of the celebrated naturalist of the same name, about a century ago, advanced many curious theories respecting the consciousness and volition of plants, in a work under the title of "The Loves of the Plants." This book at the time was much ridiculed. Plants seem to put on their most gorgeous dyes for the same purposes as the animals; and the idea of the "loves of the plants," though seemingly absurd, needs more investigation ere it be wholly discarded and ridiculed.

Plants not only actually eat and digest animal food, but also drop the insects they have destroyed, upon the ground, and thus fertilize the soil.

Dr. Hooker has described several kinds of plants which subsist upon animal food, and are hence termed carnivorous. The

[1] Wond. of Veg. S. de Vere.

[2] Loc. cit.

[3] For what follows, vid. Sci. American Dec. 22, 1874, and July 3, 1875.

present Mr. Darwin has investigated the same subject very carefully, and found that when a fly was caught by one of these plants, it would be dissolved in a gastric fluid exactly like that of the animal stomach. Pieces of beef and the like, when subjected to the same process, were acted upon in like manner. Hard mineral substances, like chalk, would, after a time, be rejected by the plant, though seized upon at first like the rest, shall we say as soon as it found out its mistake?[1]

In this country a lady has enlightened us greatly upon this subject by her interesting labors upon the bladder wort (*Utricularia neglecta*). Mrs. Treat has studied the habits of this plant very carefully, and learned that it allures animalcules by means of its bright flowers and leaves glistening with dew. The water bear and other microscopic forms of insect and vegetable life seem to be its food.[2]

Instinct and Reason.—On analyzing the various opinions formed at different times in the world's history, in regard to the reasoning power, or consciousness of action displayed by plants, we shall meet with extremists on both sides of the question. Passing over the mythological accounts of plant metamorphoses, so attractive to the refined Greek and Latin, we only advert to the mental faculties with which the ancients were pleased to endow many plants.

Many in more modern times have lavishly bestowed souls upon plants, as did Adanson, Bonnet, Hedwig and Edward Smith. Martius and Fechner, of Germany, defended these views, and were very liberal in their supply of souls to plants, even regarding them as sentient beings.

Another class, taking the opposite side of the question, among which may be reckoned Hüler, regarded plants as only susceptible to the material influences of the universe. So Descartes made all animals, so far as he could, mere automatons.

The views of naturalists of our own day are more consistent with nature and common sense; that all plants obey as infallible a law as do animals, and are subject to like influences as was observed above. Bichat in his great work on "Life and Death,"

[1] Huxley found in plants something comparable to a nervous system; Darwin something comparable to reflex action.

[2] New York Trib., Feb. 1, 1875; also Darwin's "Insect. Plants," Sir J. Lubbock's "Brit. Wild. Flowers."

admits that plants show a life as active, and a sensibility as great as do most animals.[1] Any disturbance of the conditions under which plants thrive are as fatal as the subversion of the relations upon which the lower animals and man himself depend for existence.

In the investigation of this part of our subject, we must remember that we cannot see exhibitions as great as in the more complex forms. Each plant, transitional or not, displays in the struggle for existence and the survival of its kind, a force, an influence almost as great and wonderful as is exhibited by mankind. And though standing above all this, as head and chief, man is too often forgetful of the relation he bears to the innocent weed that is in the pastures bred; too thoughtless, many times, of the vegetable on which he depends for his subsistence and being; too ignorant of the chain which leads from the lowest vegetable form, to the beauty and perfection of his manhood.—[*To be continued.*]

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THE DISCOVERY OF "TURTLE-BACK" CELTS IN THE DISTRICT OF COLUMBIA.

BY W. J. HOFFMAN, M.D.

ALTHOUGH the rude stone implements forming the subject of this paper were not found under such circumstances as to assign to them the age that some have suggested, yet the term "turtle-back" is retained for the purpose of distinguishing them from the ordinary modern rude forms, and to illustrate their relationship to some extent to the older and *typical* specimens described and figured by Dr. Abbott.[2] Before giving a description of the implements, the locality of their discovery will be necessary. The surface thus far examined, covers an area of less than two acres in extent, and is situated on the left or south bank of the eastern branch, in Uniontown, D. C., about an eighth of a mile above the bridge connecting that town with Washington city. From the branch southward, the surface gradually rises in elevation, and the region upon which the chief specimens were

[1] Loc. cit.

[2] Am. Nat., x, p. 331; Tenth Ann. Rep. Peabody Mus. Am. Archæol. and Ethnol. II, pt. 1, 1877. pp. 30–43, figs. 1–3; Eleventh Ann. Rep. Mus. Am. Archæol. and Ethnol. II. pt. 2, 1878, pp. 223-257, figs. 1–4.

found is about fifteen feet above low water mark. This sloping surface consists of fine sand, resting upon a layer of water-worn pebbles of stratified drift. The latter is a continuation of the formation known as the "cobble-stone" drift, upon which the eastern portion of the city of Washington is built. At several localities in that portion of the city, street cuts show exposures varying from five to forty feet in thickness. The several layers of worn and rounded boulders, "cobble-stones," gravel and sand, retain a perfect uniformity of stratification, showing their original deposition and arrangement through the action of water. Upon nearing the Branch we reach the shallow valley worn by that current, and the upper stratum of drift though much lower than farther back in the city, is not low enough to reach the level of that stream even at high tide. Examinations indicate, however, that the upper stratum on the north side of the stream, and the stratified gravel at the locality where the implements occur are the same, their continuity having been destroyed by the body of water just mentioned.

The rude implements were found about one hundred and fifty yards from the edge of the water, associated with quite a variety of more modern manufacture, which, by the way, were, with the exception of two or three examples, all made either of white, vitreous, or nearly transparent quartz. These represent spear-heads, arrow-heads and scrapers of great variety of sizes; some of the latter consisting of split pebbles, nicely finished by chipping, leaving the convex side to retain nearly all of the original surface. Many of the arrow-heads have been manufactured in this way, by cleaving the pebbles and finishing up a few irregularities. The smallest specimens are represented by scrapers, probably used in smoothing down arrows; these are made of tabular pieces of *semi-transparent* quartz, about the size of a five cent nickel, shaped nearly like a horse-shoe, flat at base, and have the opposite convexity nicely beveled.

The next class of implements represent manufacture of a ruder character, and undoubtedly points to greater age; to the earlier and lower state of the art of working stone for pointing weapons. These consist of quartz, and rarely chert, being rudely chipped and flaked, always leaving a greater irregular convexity upon one side of the specimen than upon the other, forming an intermediate grade between the modern forms and those termed "turtle-backs."

The latter is the class to which I desire to call special attention. These lie scattered along various small ravines formed by the rain, mingling with pebbles and modern relics *ad libitum.* They are all made of characteristic yellowish or grayish-brown quartzite, a material used in every instance, which has not been found to occur in a single individual of the two preceding varities. In form they are true "turtle-backs," if the term is admissible. The variety of forms thus far discovered are represented by that undefinable shape usually termed *celts*, and spear-heads.

An examination of a celt gives the following measurements, in inches: length 4.6, width (greatest) 2.4, thickness 1.85. The anterior surface, or that side upon which we find the "turtle-back" elevation, rises to 1.38 above the average line of the cutting edge; while the posterior or opposite side rises to but .47 of an inch beyond the same line. The top of the greater elevation retains part of the natural worn surface of the cobble-stone from which the specimen was wrought, showing the implement to have been manufactured near the locality. The cutting edge though still sharp, is very undulating, owing to the removal of large flakes during manufacture. Secondary chippings, ending in a perfectly continuous edge, shows the relic to have been a complete specimen and not a core, as has been suggested upon the discovery of similar forms. Another reason is, that not a single arrow-head or other specimen has as yet been found, even upon the closest examination, although the flakes would serve to furnish materials for arrow-heads, which could measure, when finished, nearly two inches in length. Considering the nature of quartzite, such utilized flakes should be found, as no disintegration or decomposition could obliterate their form so long as the bodies from which they have been flaked fail to present any changes upon their surface.

The only spear-head found, thus far, presents the same peculiar irregularity, but is especially interesting on account of its great comparative thickness. The specimen is 2.5 inches in length from the projection on the base to the point, 1.8 of an inch broad, and 1.2 thick. The cutting edge is sharp, continuous all around, and slightly undulating, the latter being the result of flaking. Secondary chippings are visible at different points. The anterior lateral cutting edges converge at an angle of 90°, terminating in an extremely delicate and acute point. The "turtle-back" eleva-

tion reaches its extreme elevation less than half an inch back of this, forming an angle of 64° when viewed from either side. Toward the base the descent is more gradual, where there are deeper notches than usually occur, the projections on either side somewhat worn, showing traces of having been used. From all appearance such an implement, as nearly all of this type, appears useless in attempting to penetrate the skin of anything more resisting than that of fishes.

It is very probable that these rude implements were not manufactured and employed by the Indians of historic times who inhabited this region. The question is asked, Why then do these implements occur with more modern ones upon the surface, or in washes? The only reason that can be given is, that the rude forms occupying that portion of the stratum of sand resting upon the gravel, and those of modern manufacture occupying the surface of the later deposit of earth and sand, were brought together by the removal of the intervening siliceous matter through the prolonged and repeated agency of rains. Thus the surface relics were gradually let down, as it were, as the sand and earth were washed away. This may appear unsatisfactory, but the suggestion is based upon the following reasons: *first*, that the sand being fine and easily removed by water (through the agency of rains) falling over this locality and over the bluffs, follows the most natural course towards the stream, taking with it the light silicious particles, and washing them away from the pebbles, stones and implements, allowing them to be deposited in an indiscriminate mixture in the little water courses and ravines; *second*, that this has been the case is apparent from the fact of its occurrence in several places at this time; also that small embankments and hillocks occur, consisting of gravel thus deposited or brought together by the removal of the lighter soil; and at this day, after any continued or hard rains, numerous accumulations of pebbles, amongst which we find implements, are formed by the removal of earth and sand by the temporary streams.

In this way the surface remains have not been carried away from the localities upon which they had rested, but were gradually dropped to a lower horizon, until after a time they reached the stratum containing the rude and more ancient varieties.

In this connection I shall speak of several localities in Pennsylvania, one of which occupies a position in the eastern portion

of the city of Reading, and another a short distance below that city. The rude implements found at these places have been remarked upon by Mr. A. F. Berlin in a recent number of the *American Antiquarian*.[1] The first named locality is the one upon which Mr. Berlin first noticed the occurrence of rude implements bearing the typical characteristics of so-called "turtle-backs." A few days after this discovery I visited the place, and found various examples, consisting of "celts," spear-heads, arrow-heads and scrapers. These were found over a small area only, occupying the top of a small limestone bluff. A small stream known as Mineral Spring creek passes near the base of this bluff, the intervening soil consisting of loam and dèbris from the more elevated regions. Immediately above, and resting upon the stratum of limestone, is a stratum of sand and pebbles, which has been washed away along the immediate declivity of the embankment, exposing the rude relics above referred to as found by Mr. Berlin. I found that this stratum of sand was covered by earth and gravel from the neighboring hillside, with which it was continuous, excepting along the greater declivity where the rain had worn away the super-stratum, exposing the sub-stratum of sand and rounded and worn pebbles, which occurred in accumulations where they had been washed into the ravines. Modern types were also found here associated with the rude implements, but the latter were not found on the upper stratum, even where the ploughing of long continued cultivation and local denudation has removed considerable soil; but farther down the modern forms have been washed down and lowered by the removal of sand and earth to reach the more ancient stratum containing the "turtle-backs."

This stratum of sand and gravel, or, more properly speaking, pebbles, continues eastward horizontally, as was proven by the digging of a well. Nearer the hill, where this excavation was made, the workmen reached a layer of stratified sand, pebbles and cobble-stones at a depth of about forty feet. Upon examination this proved to be the level (if run horizontally towards the bluff) of the one containing the implements. Since then this stratum has been detected along the valley a short distance, proving it to be the same, the great amount of dèbris and soil from the mountain side being accounted for where the well was

[1] Vol. i, No. 1, 1878, pp. 10–12, pl. facing p. 16.

dug, because that lies nearer the slope which rises at an angle of about 16°. This fluviatile drift, as it seems to be, formed the bed of an ancient body of water; but whether the implements found date to that period or a little later, it is impossible to decide. Were it possible to continue the search by digging at various places and depths to ascertain if the implements occur elsewhere than at the bluff, more might be learned, though it is very improbable, as will be shown farther on.

Dr. F. M. Endlich informs me of the occurrence of ancient shore lines on the eastern declivity of the neighboring hills, which may mark the surface of the same stratum occurring on the western side, as the continuation may be traced interruptedly around the hills, following the course of the Schuylkill river. The implements found at the last named locality present no appreciable difference from those occurring at Uniontown. Their conformation, mineralogical composition, typical workmanship and even the color of the materials correspond in all respects. Forms from Reading are figured in the *American Antiquarian*[1] by Mr. Berlin. Some in my possession are identical in form, but several are more typical of that class found in the drift at Trenton by Dr. Abbott, and the illustration[2] given by him represents one celt perfectly. This striking similarity is certainly remarkable; and considering the persistence with which the New Jersey celts are reproduced at Reading and at Uniontown, there appears to be greater relationship between the manufactures of the three varieties than has been accredited, or that we may be able to account for. One, and it may be be considered the strongest objection to this suggestion, is, the difference in altitude above the tide water between the several localities. Another is in regard to the geological positions of the implements.

In another locality, one mile south-west of Reading, on the right bank of the Schuylkill river, numerous specimens of these similar rude implements have been obtained. They likewise consist of the same species of quartzite, and are typical "turtle-backs." This locality covers about two or three acres in extent, sloping very prominently towards the river. The soil is sandy, and differs in this respect from that lying immediately around it, has been under cultivation for the last sixty or seventy years, and

[1] Vol i, No. 1, pl, facing p. 16, figs. 1–3.

[2] Tenth Ann. Rep. Peabody Mus., i, 1877, p. 33, fig. 1, a–b.

through the repeated plowing, harrowing and the effects of rain, much of the original super-stratum have been removed, exposing the older layer of stratified sand and river gravel. With the latter we find more of the rude implements, which consist of celts, spear-heads, arrow-heads and scrapers.

In all of the localities referred to, a peculiar variety of quartzite has been employed, which was found to exist in the "cobble-stone" drift in the District of Columbia. At Reading we do not find it, nor within forty miles of that city, to my knowledge. In each of these regions, the specimens partake of a character of workmanship that is rude and primitive in the extreme, and just such implements as might reasonably be supposed to be required by a rude and primitive people.

Assuming that such a race preceded the Indians—of which there is scarcely any doubt—several important points present themselves which are difficult of solution, viz: *First,* the length of time that elapsed between the disappearance of one race and the appearance of their successors; *second,* at what approximate period the manufacturers of the rude implements occupied these regions; and *third,* whether the colony occupying the region about the Eastern Branch, was of immediate tribal connection of those whose remains survive at Reading?

In answer to the first point, nothing can be definitely known, though it would appear from slight geological evidence, that considerable time had elapsed. Various traditions have been handed down to us regarding a race corresponding to the Eskimo, which, if accepted, would allow scarcely any time for the soil to have been without occupants; for that race was, according to said tradition, driven northward by the encroachments of the Indians.

Regarding the second point, the locality in the eastern portion of Reading furnishes the greatest antiquity. Here the original stratum, in one section of which implements have been found in such a condition and under circumstances to lead us to infer that they had been buried there by the gradual accumulation of detritus from the mountains; but whether any specimens occur in the stratum of drift, at any distance under this upper accumulation, is not known. The excavation, showing the drift stratum at forty feet below the surface, is nearer the mountain, and the mass of earth and débris may have required but a short time for deposition geologically. Beyond this elevation the valley was, at some

remote time, submerged, but has become narrowed down through the same agency from different directions. Being guided by the manner in which the implements were found, and other meagre evidence, one would suppose them to date back to the lacustrine period, but in this we find difficulties which can be explained in answer to the third point.

The difference in elevation between this locality and that on the banks of the Schuylkill river (as well as that on the Eastern Branch) is too great for them to have been occupied simultaneously, unless we throw out the suggestion of a lacustrine period. Acting upon this, the matter becomes more comprehensible, from which may be deduced the following propositions, viz:

1st. That the three localities were occupied by a similar people, at or nearly at the same time.

2d. That these people lived chiefly upon fish, as is inferred from the implements which, under *ordinary* circumstances, would be worthless in the chase.

3d. That these typical forms of rude workmanship, indicate greater antiquity than we find represented in the rudest forms of Indians who subsequently occupied the same localities. And—

4th. That the position of some of the implements in the stratified drift, and their relation in this respect to the location of modern relics, indicates an indefinite lapse of time from the disappearance of this primitive race to the appearance of the Indians proper, whose rudest forms of workmanship are found near or upon the surface.

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RECENT LITERATURE.

BREHMS'S ANIMAL LIFE.[1]—The volumes that have been previously noticed of the series, have related to the vertebrate animals, which are naturally in a work of a thorougly popular character such as this, treated of at much greater length than the invertebrates. The present volume has been written by Prof. Oscar Schmidt, of the University of Strasburg, who is distinguished for his knowledge of the structure and mode of development of the lower animals.

This volume begins with the Crustacea, and descends through

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflage. Vierte Abtheilung. Wirbellose Thiere. Zweite Band. Die Niederen Thiere. Von Dr. OSCAR SCHMIDT. Krebse, Würmer. Weichthiere, Stachelhäuter, polypenartige Thiere, Urthiere. Mit 366 Abbildungen im Text und 16 Tafeln, von JOHANNA SCHMIDT, EMIL SCHMIDT und ROBERT KRETSCHMER. Leipzig, Verlag des Bibliographischen Instituts, 1878. 11 Parts. 40 cents a part, for sale by B. Westermann & Co., New York.

the worms to the Mollusca, the Echinoderms and the Cœlenterates to the Protozoa. While we cannot agree with the learned author in some of his views on classification, the reader may be sure that the volume is a careful and reliable presentation of the more interesting facts regarding these creatures, and which should be the property of every well informed person.

FIG. 1. — *Sacculina carcini*. Natural size.

In these days one can hardly be considered as liberally educated, who is not conversant with the physical theories as to the origin of the different forms of life; and as there are several avenues which lead up to the Vertebrates from the lower animals, no wonder that a knowledge of the lower animals, especially the groups described and figured in this volume, is quite requisite. It should be said, however, that the anticipation of vertebrate characters discoverable in the Ascidians, the Worms and the Molluscs, are recondite, and only appreciable after careful embryological and anatomical studies. This subject is only incidentally referred to by Prof. Schmidt, and perhaps the introduction of too many anatomical cuts and schematic drawings would be considered as out of place in such a work as this.

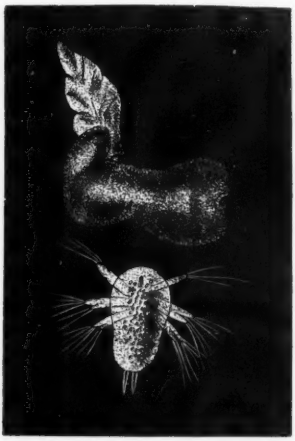

FIG. 2—*Peltogaster curvatus;* beneath is the larva or nauplius of Parthenopea, magnified 200 times.

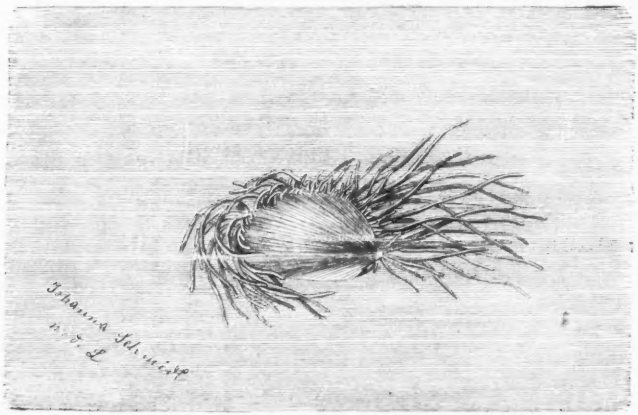

FIG. 3.—Lima flying through the water by opening and shutting its valves.

As it stands, the volume before us is superbly illustrated, and to American students, as we have previously remarked, who may read German with difficulty, the book will be a storehouse of admirable studies from nature of the leading types of animal life.

Many new wood-cuts are added in this second edition; some of these were drawn by Prof. Schmidt's daughter, Johanna, who spent a winter in Dr. Dohrn's Zoölogical Station at Naples, observing and drawing the animals kept alive in the mag-

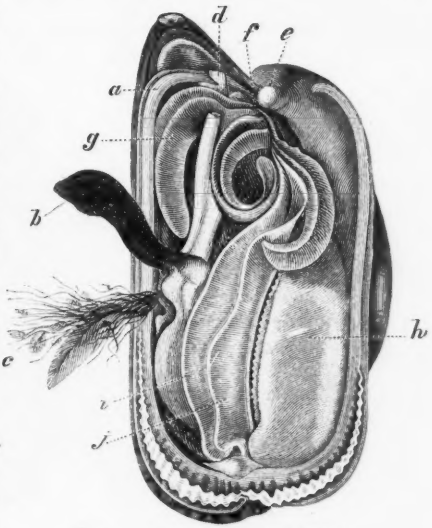

FIG. 4.—Anatomy of the Mussel.

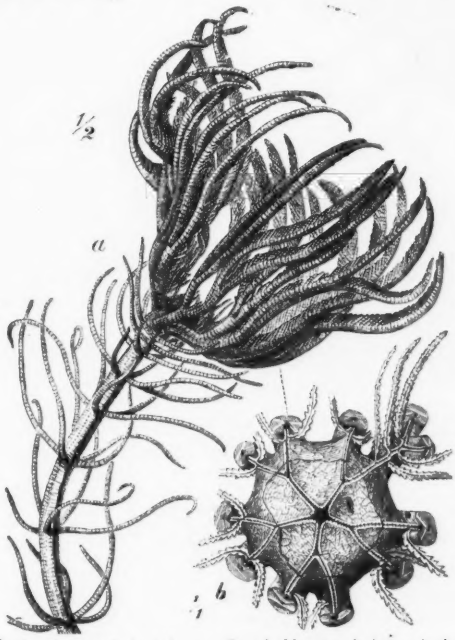

FIG. 5.—*Pentacrinus caput-medusæ.* One-half natural size. *b*, the calyx of the same seen from above with the arms cut off. Natural size.

nificent aquarium of that institution, which has proved such a benefaction and stimulus to working naturalists in Europe. The

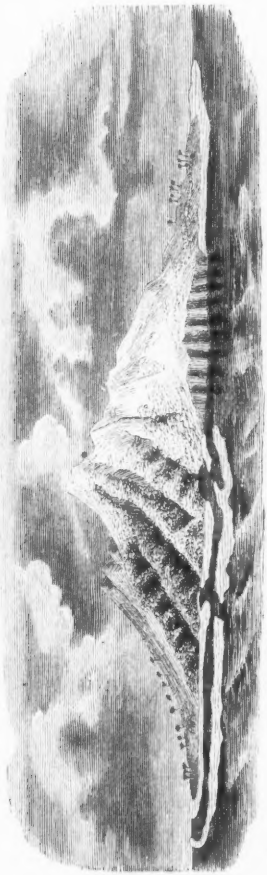

FIG. 6.—High Island with a barrier and fringing reef.

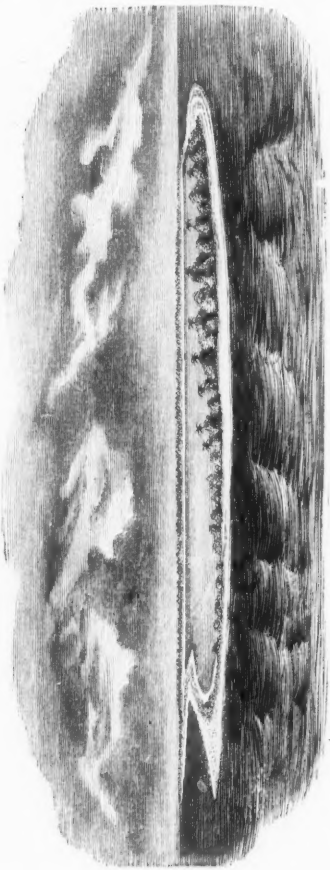

FIG. 7.—Coral Island or Atoll.

author has also been aided by Dr. Simroth, well known for his anatomical studies on the invertebrates, especially the Echinoderms.

FIG. 8.—Section through a coral reef.

As an example of the mode of treatment of his subject we may refer to the account of the Hydroid polyps and coral polyps.

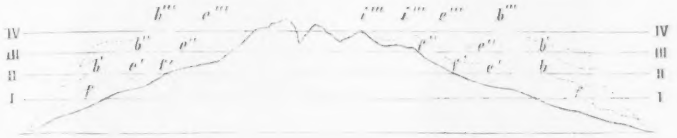

FIG. 9.—Schematic section through an island, indicating the different steps in the formation of an atoll.

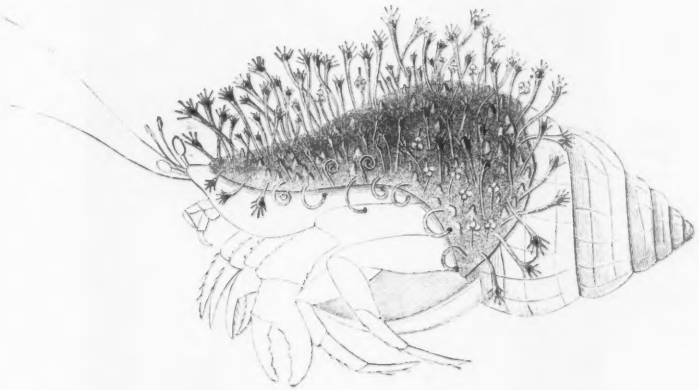

FIG. 10.—Colony of *Hydractinia echinata* on a Buccinum shell inhabited by a hermit crab. Natural size.

The Hydractinia, jelly fishes and other forms that lead up to the Anthozoa or genuine polyps, are discussed, and the latter are fully described, and their mode of development as originally worked out by Lacaze-Duthiers and Haeckel, as well as the that of Halcyonoid polyps and sea-pens. A lengthy chapter is devoted to the subject of coral reefs and coral islands, based on the researches of Darwin, Dana, Ehrenberg and other naturalists. The accompanying illustrations will convey an idea of the mode of pictorial treatment.

Of the full-page illustrations those of the Octopus or Kraken, the paper Nautilus, the group of Holothurians, are especially noteworthy. In conclusion we can only praise in the highest terms this great work, the preparation of which has been entrusted

to some of the best men in Germany, who combine with a thorough

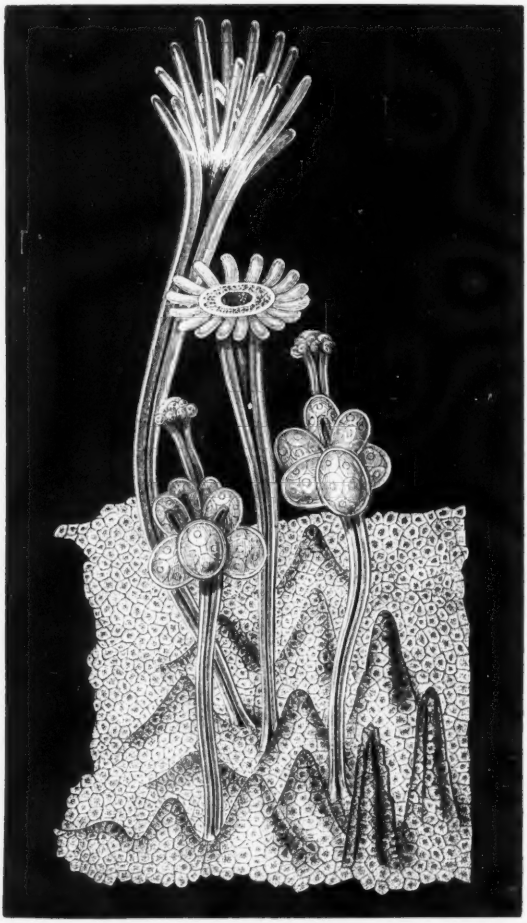

Fig. 11.—Group of a female colony of *Hydractinia echinata*. Enlarged.

special knowledge, the art of setting forth in an interesting and attractive way the history of animal life.

TENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY, F. V. HAYDEN IN CHARGE.[1]—This

[1] *Tenth Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Colorado and parts of adjacent Territories.* Being a Report of progress of the Exploration for the year 1876. By F. V. HAYDEN, U. S. Geologist. Washington, 1878. 8vo, pp. 546, with many maps and plates.

volume is a worthy member of the large series of annual reports of this survey, and is quite as important and rather more fully illustrated than any of its predecessors. The field work reported upon embraced the completion of the explorations known as the Survey of Colorado and portions of adjacent Territories, and was finished in 1876.

The first part, relating to geology, contains a report of Dr. C. A. White on a portion of North-western Colorado, of F. M. Endlich, Geologist of the White River division, of Dr. A. C. Peale, Geologist of the Grand River district, and of W. H. Holmes on the geology of the Sierra Abajo and West San Miguel mountains. These reports are followed by an elaborate essay by Mr. Endlich on the volcanic rocks of Colorado.

The second part, topography, embraces reports by A. D. Wilson on the primary triangulation of Colorado; by Henry Gannett on the arable and pasture lands of Colorado; by G. B. Chittenden on the White River district, and by G. R. Bechler on the Yampa River district.

The third part, archæology and ethnology, is rich in new facts regarding ancient ruins of South-western Colorado, contributed by Mr. W. M. Holmes and Mr. W. H. Jackson. This portion is illustrated by a large number of plates, and is accompanied by essays on the Chaco cranium, and on the Indians of Nevada, California and Arizona, by Dr. W. J. Hoffman.

Part four, palæontology and zoölogy contains an essay by Mr. Lesquereux on the fossil plants secured by the Survey in 1877, and a report by A. S. Packard, Jr., on the insects affecting the cranberry, &c. The maps are in some cases colored, and add greatly to the interest and value of the report.

Fifty of the plates illustrate the remarkable cliff dwellers in southern Colorado and northern New Mexico. A very interesting series of chapters treats of the geology of Colorado, and there is much besides of great interest to the general as well as the scientific reader. Unfortunately, Congress has only ordered the printing of 4,500 copies, and the demand far exceeds the supply.

This Survey has done so much, by its publications, to spread the knowledge both at home and abroad of the remarkable country constituting its field of labor, that every annual report finds an increasing number of readers, and it is not surprising, therefore, to meet with expressions of regret at the want of liberality on the part of Congress in printing too small editions, expressed in our own and foreign scientific journals.

MOSELEY'S STRUCTURE OF THE STYLASTERIDÆ.[1]—It will be remembered that Mr. Moseley substantially set at rest all doubts

[1] *The Croonian Lecture, On the Structure of the Stylasteridæ, a family of the Hydroid Stony Corals.* By H. N. MOSELEY, F.R.S. (From the Philosophical Transactions of the Royal Society. Part i, 1878.) London. 4to, pp. 78, 11 plates.

as to the hydroid nature of Millepora, first suggested by Agassiz and endorsed by Verrill. The present admirable and masterly study certainly proves, beyond doubt, the hydroid nature of the family of beautiful coral-like structures, called from the name of the typical genus (Stylaster) *Stylasteridæ*.

Most of the specimens studied by Mr. Moseley were obtained at a single haul of the dredge aboard the *Challenger*, at a depth of 600 fathoms, off the mouth of the Rio de la Plata, in 1876. It was the examination of this set of specimens which first convinced him that the *Stylasteridæ* were Hydroids and not Anthozoans. The hard and soft parts are described and very fully and beautifully illustrated, the drawings being large and thoroughly intelligible.

As in most all Hydroids, the sexes are on different stocks which have a tendency to grow in a flabellate form with alternate germination. The family is placed with the *Milleporidæ* in a separate sub-order named by Mosely, *Hydrocorallinæ*. This sub-order, its families and genera, are described in full, and an essay is given on the pedigree of the *Hydrocorallinæ*. The author suggests the former existence of a hypothetical *Archistylaster*, and regards *Sporadopora* as "the most ancestral Stylasterid at present known." The essay closes with a short chapter on the distribution in space and time of the *Stylasteridæ*.

RECENT BOOKS AND PAMPHLETS.—Report upon the Reptiles and Batrachians collected during the years of 1875, 1876 and 1877, in California, Arizona and Nevada. By Dr. H. C. Yarrow and H. W. Henshaw. Washington, 1878. 8vo, pp. 23.

List of marine Fishes collected on the coast of California, near Santa Barbara, in 1875, with notes. By Dr. H. C. Yarrow and H. W. Henshaw. Washington, 1878. 8vo, pp. 7.

On the fossils called "Granicones;" being a contribution to the histology of the Exo-skeleton in "Reptilia." By Prof. Owen, C.B., F.R.S., etc. (Reprinted from the Journal of the Royal Microscopical Society.) London, 1878. 8vo, pp. 4.

Preliminary Report of the field work of the U. S. Geological and Geographical Survey of the Territories for the season of 1878. By F. V. Hayden. Appendix containing reprints of early papers by the author from the American Journal of Science and Arts. Washington, D. C. 8vo, pp. 29.

A Naturalist in the Magdalen Islands. By Charles B. Cary. (Illustrated.) 8vo, cloth, pp. 93. Boston, 1878. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia, 1878. 8vo, pp. 329–376. From the Society.

The American Journal of Science and Arts, No. 97, Vol. xvii, Jan. 1879. 8vo, pp. 1–92, pls. iii–x. New Haven, J. D. & E. S. Dana, 1879.

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On the Mineralogy of Nevada. By W. J. Hoffman, M.D. (Extr. from the Bulletin of the U. S. Geol. and Geograph. Surveys, Vol. 4, No. 3.) Washington, July 29, 1878. From the author.

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Kupferoxyd-Ammoniak als Oxydations-mittel. Von Oscar Loew. (Separat-Abdruck aus dem Journ. f. Prakt. Chemie, 12mo, pp. 298–302. Leipzig, 1878.) From the author.

Ueber Oxydation des Eiweisses durch den Sauerstoff der Luft. Von Dr. O. Loew. (Separat-Abdruck aus der Zeitschrift f. Biologie.) 8vo, pp. 294–296, 1878. From the author.

The Natural Sciences in Common Schools. By Prof. Jacob Ennis. (Repr. from the Journal of the Franklin Institute, July, 1877.) 8vo, pp. 3. From the author.

On some Dark Shale recently discovered below the Devonian Limestones, at Independence, Iowa; with a notice of its Fossils and Description of New Species. By S. Calvin, Prof. of Geology State University of Iowa. (Ext. from Bulletin of U. S. Geol. and Geograph. Survey, Vol. iv, No. 3.) 8vo, pp. 725–730. Washington, July 29, 1878. From the author.

Studien über fossile Spongien. Dritte Abtheilung; Monactinellidæ, Tetractinellidæ und Calcispongia. Von Karl Alfred Zittel. (Aus den Abhandl. der K. bayer. Akad. der Wissenschaften ii, Cl. xiii, Bd. ii, Abth.) 4to, pp. 48, pls. xi, xii. München, 1878. From the author.

Views of the War Department concerning the Public Surveys of the Territories of the United States; being Appendix NN3 of the Annual Report of the Chief of Engineers for 1878. 8vo, pp. 1661–1666. Washington, 1878. From the Department.

A Monograph of the Silurian Fossils of the Girvan District in Ayrshire, with special reference to those contained in the "Gray Collection." By H. Alleyne Nicholson, M.D., etc., and Robt. Etheridge, Jun., F.G.S. Fasciculus i. (Rhizopoda, Actinozoa, Trilobita.) 8vo, pp. 135, pls. i–ix. W. Blackwood & Sons, Edinburgh and London, MDCCCLXXVIII. From the authors.

Discoveries of the United States Fish Commission: Notices of fifty species of east-coast fishes, many of which are new to the fauna. By G. Brown Goode and Tarleton H. Bean. (Repr. from Am. Journ. of Science and Arts, Vol. xvii, Jan., 1879.) 8vo, pp. 39–48. From the authors.

Description of a new family and genus of Lower Silurian Crustacea. By A. G. Wetherby. (From the Journ. of the Cincinnati Society of Nat. History, Jan., 1879.) 8vo, pp. 4. From the author.

The Distribution of the North American Flora. A Lecture. By Sir Joseph Dalton Hooker, K.C.S.I., Pres. R. S. Delivered on April 12, 1878, before the members of the Royal Institution of Great Britain. (Repr. from the Gardener's Chronicle, Aug., 1878.) 8vo, pp. 8. From the author.

Evolution Evolved; a part of the problem of human life, here and hereafter. Containing a review of Darwin, Huxley and Haeckel. By Wilford. 8vo, pp. 522. Hall & Co., Publishers, 234 Broadway, New York, 1878. From the author.

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GENERAL NOTES.

BOTANY.

A TREE AS A FRATRICIDE AND CANNIBAL.—On the bank of the West Nishnabatona river, near Tabor, Iowa, there stands a large sycamore, *Platanus occidentalis*. About ten feet from it is the decayed stump of another of the same species. The diameter of each is about three feet.

Last season, during a freshet, the river ran over its bank past them, uncovering their roots on one side. In this way six different places were shown where large roots from the living tree had become grafted to those of the dead one. For convenience we will designate the dead tree as A, and the living one as B. While in one case the roots of B appear to have met the root of A squarely and followed it, investing it; in other cases the roots from each had crossed each other and grown to a considerable size before uniting. In every case, however, but one root lived beyond the union, and that one belonged to A. In most cases, also, while both lived above the union, that from B was much the larger. In one case that from A had died, leaving the remaining living root joined to B with a curious acute angle in it. One instance was seen of the grafting of two roots from B to each other, in a similar way. A young ash was growing between A and B. It is needless to say that its roots showed no tendency to unite with those around them. Doubtless many similar junctions remained unrevealed. The stump of A was so rotten that it could be easily crumbled with the fingers. Its roots, as before stated, were living some distance above their union with those of B, and doubtless have traitorously carried the nourishment which they helped store in A in its prosperous days, into the root sent out from B, by reversing their action. We may say, therefore, that B has first starved A to death, then by using its own roots as feeders has been devouring it.

This glimpse into the hidden life of trees suggests several interesting inferences:

1. All trees of the same species, in a grove together, may become organically connected. Perhaps this may be turned to their mutual advantage when contending with other kinds.

2. Weaker members of a grove may be killed, not simply by lack of sunshine, air, etc., but they may be literally bled to death by their more powerful neighbors.

3. It is seen how the growth formed by a failure or unsuccessful individual is utilized directly in the economy of nature, just as when in the animal world the large fish live on the little ones.—*J. E. Todd.*

On the Nectar of Flowers—Mr. Wilson read a paper on this subject before the British Association, which may interest American botanists. He discussed the extent to which the visiting of plants by insects in search of sugar occurs in nature, since this action is believed by some biologists to have been the cause that determined the existence, forms, colors, and odors of flowers. The number of flowers required to yield a pound of honey—viz: two and a half millions—was mentioned as showing what an enormous number of visits an insect collecting honey must make in order to obtain an appreciable quantity, and as proving that the industry of the bee is in reality necessary to its very existence.

BOTANICAL NEWS.—Botanists will be interested in the portion of Sir J. D. Hooker's recent anniversary address as president of the Royal Society of London, which appears in *Nature* for Dec. 5th. He reviews Comte Gaston de Saporta's essay entitled L'Ancienne Végétation Polaire, in which the author takes the ground that life first appeared in the northern circumpolar area of the globe, and that this was the birthplace of the first and of all subsequent floras; the initial conditions of terrestrial life following upon the emergence of the earlier stratified rocks from the Polar ocean.

Among recent botanical works are Heer's History of Vegetation in Switzerland, and Christ's Das Pflanzenleben in der Schweiz.

The forthcoming eleventh report of the U. S. Geological and Geographical Survey of the Territories, in charge of Prof. Hayden, will contain the reports of Sir J. D. Hooker and Prof. Asa Gray on the results of their botanical explorations in the western Territories in connection with this survey.

Trimen's *Journal of Botany* for December contains an article on the pro-embryo of Chara, an essay in morphology, by S. H. Vines.

In the *Bulletin* of the Torrey Botanical Club for November, Dr. Asa Gray records two remarkable forms of Trillium. Mr. C. G. Pringle notices some north-eastern plants; and the discovery of a truffle new to the North American flora, by Mr. W. R. Gerard, is recorded.

A Catalogue of North American Ferns (north of Mexico) in the Davenport Herbarium of the Massachusetts Horticultural Society is to be issued by Mr. George E. Davenport, 8 Hamilton Place, Boston, Mass., provided that he can obtain a sufficient number of subscribers to meet the expense. The price will not exceed fifty cents.

In the *Botanical Gazette* for December, Dr. George Vasey adds to and corrects the catalogue of the forest trees of the United States. Mr. Thomas Meehan writes concerning *Cassia nicticans*. J. R. Lowrie gives a list of the trees and plants inhabiting a plantation which has been protected, for a series of years, both from the inroads of cattle and the labor of farmers.

ZOÖLOGY.[1]

THE BREEDING HABITS OF THE EEL—A CORRECTION.—Farther examinations of additional specimens of the eel, convince me that an error as to the sex of the eel was made in my article in the January NATURALIST. The motile bodies whose active movements misled me were not spermatozoa, but yolk particles, with an unusually marked Brownian motion. The male sex has yet

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

to be discovered. It should be said that the subject is one presenting great difficulties, as formerly stated by Burnett. The spermatic particles of the perch and smelt, are exceedingly minute, about $\frac{1}{10.000}$ inch in diameter, and in these we have thus far found it impossible to detect the "tails" with a $\frac{1}{16}$ inch objective.

I have been informed by John Sears, of Danvers, Mass., that he found young eels, somewhat less than an inch in length, with the yolk-sac still attached, at the mouth of a shallow brook running into salt water at Danvers. This was during the month of March; the season was earlier than usual, the ice having broken up in February. This would indicate that the parent eel must have spawned in December. As Mr. Sears is an observing field naturalist, and has noticed the breeding habits of other fish, we suppose him to be correct in the identification of the young eel. We would inquire whether any one else has ever observed eels so young and small as these, and with the yolk-sac still attached.

Mr. Sears informs us, that at Danvers the trout begins to spawn in January, beginning then to make the shallow holes in gravelly places. He has noticed perch spawning in midwinter, in ponds in shallow water, their movements being observed through the ice; at this time the fins become red on the edges. On the other hand, the bream spawns in spring and summer. The horned pout, he says, breeds in holes in the gravel in midsummer.—*A. S. Packard, Jr.*

A Gall-Inhabiting Ant.—The empty dwellings of many animals furnish suitable abodes for others. The abandoned shell upon the beach finds an eager house-hunter in the hermit-crab; shells of Helices are sought by various European mason-bees and wasps as a fitting place in which to build their cells; two species have been found in New England to choose the concave vault of the oak-apple for the same purpose.

I can now record two instances in which galls have been chosen by an ant, *Stenamma gallarum* n. sp., as the home of the colony. The first colony observed was in a gall of *Gelechia gallæ-solidaginis* Riley, upon a dead but unbroken stalk of golden-rod. From pupæ found in this gall on the 31st of May, and placed in a vial under the care of a few workers, there matured three females, one upon each of the following days: June 20th and 23d, and July 7th. The second colony was found while upon an excursion with Mr. K. Mitsikuri, on the 22d of May, 1878, in a fallen gall of *Cynips spongifica* O. S. It was more populous than the other colony, and occupied the central cell, as well as the space between the kernel and the shell of the gall. Except the queen, who was without wings, the community consisted of workers and larvæ only.[1]—*W. H. Patton.*

[1] *Stenamma gallarum* n. sp.

Female.—Yellowish; head, scutellum and petiole above, and incisures of thorax darker; eyes, and spot at insertion of wings, black; the segments of the abdomen with dark-brown borders, the border on the first segment broad. Length, 3 mm.

Dried specimens become darker colored. Three pinned ♀ present the following

A HUMMER'S MEAL.—Mr. A. R. Wallace, in a recent number of the *Fortnightly Review*, says, concerning the tongues of hummers: "This tubular and retractile tongue enables the bird to suck up honey from the nectaries of flowers, and also to capture small insects; but whether the latter pass down the tubes, or are entangled in the fibrous tips and thus drawn back into the gullet, is not known."

Mr. Wallace's remark led to some investigations during the past summer, the results of which do not entirely agree with his statement. Two hummers were attracted to the house by a saucer of syrup placed on the window-sill. Each day they would come and satisfy their hunger. In each instance they would alight on the edge of the saucer, and lap up the syrup as a dog would lap water. The question as to whether insects "pass down the tubes or are entangled in the fibrous tips and are thus drawn back into the gullet," was also solved. Insects too large to pass through these tubes being placed in their way, the birds were observed to take them as readily as smaller ones. The insects were evidently secured by adhesion to the saliva of the tongue-tips, and thence drawn into the gullet. In my opinion, these tubes of the tongue connect with the lungs rather than with the abdomen. These experiments were abruptly terminated, one day, by the approach of a third hummer, a male, who drove the others from the window, and in a fit of rage darted at one of the pair, thrust its bill well through its body, and both fell dead on the ground.—*W. H. Ballou, Evanston, Ill.*

RECENT PAPERS ON CRUSTACEA.—From Mr. W. N. Lockington we have two papers on Crustacea—"Remarks on the Thalassinidea and Astacidea of the Pacific Coast of North America" (*Annals and Magazine of Nat. Hist.*, Oct., 1878), and "On the Porcellanidea of the West Coast of North America" (*ibid.*, Nov., 1878). In the first paper eight Thalassinidea and nine Astacidea are enumerated. One new species (*Gebia rugosa*) is described; *Callianidea typa* is added to our fauna (it was described by Milne

characters: Antennæ 11-jointed, joints 3–7 very short, the 8th joint a little longer, joints 8–10 with a brown annulus. Head, thorax and nodes of the petiole striate, metathorax with two stout spines, first node of the petiole with a short cariniform tooth at base beneath, second node with three very short, blunt teeth in the median line beneath. Body clothed with thinly-scattered, erect hairs; wings white, ciliate; head, thorax, and nodes, light-brown; mandibles, antennæ and legs, pale yellow, the femora sometimes darker; abdomen, dark-brown; the bases of the segments above and the venter testaceous, the first segment with a broad yellow band at the base.

Worker.—Pale yellow, eyes black, first segment of the abdomen with two dark-brown spots above, which sometimes unite to form a broad band; the spines on metathorax more slender than in the ♀. The second node of the petiole without teeth beneath. Length, 2 mm.

The worker differs from the European *S. westwoodii* in having no spine beneath the second node of the petiole, and the species is easily distinguished by its color.

Connecticut.—Inhabiting galls of *Gelechia gallæ-solidaginis* Riley, and *Cynips spongifica* O. S., and frequenting the flowers of Violet and Potentilla.

Edwards from New Ireland). In regard to the Genus *Panulirus*, we would say that three of the four species mentioned (*guttatus*, *gracilis* and *americanus*) are East Coast species, and that there is no authority whatever for reporting them from the West Coast. The second paper gives an analytical key and notes upon 16 species of Porcellanidea from the West Coast, nine of which are believed to be new. *Petrolisthes armatus* (Gibbes) Stm. is also credited to the West Coast.

In "Notes on Cladocera," by E. A. Birge (Nov., 1878), we have almost the first systematic contribution to a knowledge of the American forms of this group of Crustacea. Thirty-six species are enumerated, of which twenty, and one variety, are new. A new genus (*Crepidocerus*) of the family *Lynceidæ* is also proposed.—*F. S. Kingsley.*

The Nebaliad Crustacea as Types of a New Order.—The *Nebaliadæ*, represented by the existing genus *Nebalia*, have generally been considered to form a family of Phyllopod Crustacea. Metschnikoff, who studied the embryology of *Nebalia*, considered it to be a "Phyllopodiform Decapod." Besides the resemblance to the Decapods, there is also a combination of Copepod and Phyllopod characteristics. The type is an instance of a generalized one, and is of high antiquity, having been ushered in during the earliest Silurian Period, when there were, when we regard the relative size of most Crustacea, and especially of living *Nebaliæ*, gigantic forms. Such was *Dithyrocaris*, which must have been over a foot long, the carapace being seven inches long. The modern *Nebalia* is small, about half an inch in length, with the body compressed, the carapace bivalved as in Limnadia, one of the genuine Phyllopods. There is a large rostrum overhanging the head; stalked eyes; and, besides two pairs of antennæ and mouth-parts, eight pairs of leaf-like, short, respiratory feet, which are succeeded by swimming feet. There is no metamorphosis, development being direct.

Of the fossil forms, *Hymenocaris* was regarded by Salter as "the more generalized type." The genera *Peltocaris* and *Discinocaris* characterize the Lower Silurian Period, *Ceratiocaris* the Upper, *Dictyocaris* the Upper Silurian and the lowest Devonian strata, *Dithyrocaris* and *Argus* the Carboniferous Period. Our existing north-eastern species is *Nebalia bipes* (Fabricius), which occurs from Maine to Greenland.

The Nebaliads were the forerunners of the Decapoda, and form, we believe, the type of a distinct order of Crustacea, for which the name *Phyllocarida* is proposed.—*A. S. Packard, Jr.*

Camptolæmus labradorius.—The first specimen of *Camptolæmus labradorius* (pied duck) known to occur in this locality was taken Dec. 12, 1878. It is interesting, as it adds one more species to the list of birds of Chemung county, N. Y., and assists in clear-

ing up the geographical distribution of species. *C. labradorius* is rare everywhere, and its occurrence so far south in the interior gives special interest to the subject.—*W. H. Gregg, M. D., Elmira, Dec.* 14, 1878.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—Mr. W. H. Pratt sends us a brochure from the forthcoming part of the Proceedings of the Davenport (Iowa) Academy of Natural Sciences, pp. 156–162, upon the shell-beds in the vicinity of Davenport. They are not regarded as artificial, but were pushed up the bank of the river by moving ice at its breaking up in the spring.

In the *Journal* of the Cincinnati Society of Natural History, Dr. Charles L. Metz describes the pre-historic monuments of the Little Miami valley, embracing all of Columbia and portions of Anderson and Spencer townships. The paper is illustrated by a map in which the remains are indicated by means of the symbols in the Smithsonian circular. As this is the first attempt to use these signs in print in our country, Dr. Metz is to be congratulated on his success, and it is hoped that he will not let his labors cease at this point.

Stephen Barton, of Vidalia, Cal., commences, in the *Iron Age* of that place, a series of letters on the "Early History of Tulare." While it is well to help the local press, it is also a great pity that some of the best aboriginal material ever collected in our country has been lost by publication only in the daily papers; notably the letters of Mr. Taylor, of Mr. Barton's own State.

In the Princeton *Review* of November, Prof. John LeConte discusses man's place in nature. We have seen a notice of a work of 304 pages, by John H. Blake, printed at the Salem press, describing a collection from the Ancient Cemetery at the bay of Chacota, Peru. As we have not seen the work, it is impossible to speak of its merits. The same is true of other anthropological publications; it is hoped that those who wish their works on anthropology noticed in these columns will send a copy to the editor of this department.

In the *Contemporory Review* for November, Mr. F. Lenormant, the distinguished Assyriologist has an article on "Books and monuments bearing upon figured representations of antiquity."

Die Vorgeschichte des nordens nach gleichzeitigen Denkmälern, is the title of a paper in No 43 of *Das Ausland.* In No. 41 of the same journal, is a discussion of the moral relationship between men and animals.

M. D. Kaltbrunner has published at Zurich a work entitled, "Manuel du Voyageur." (Wurster & Co.) Three hundred pages

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

are devoted to anthropology. The work is reviewed in the *Athenæum* for November.

In Mittheilungen der anthropologischen Gesellschaft in Wien, Dr. Moriz Benedikt makes some communications on craniometry. This subject is becoming of great importance, inasmuch as a great deal of the work done is vitiated by the multiplicity of methods employed.

The most important communication which has come to us in the last month, is the paper of Prof. Paul Mantegazza, in No. 2 of *Archivio*, Florence, upon the third molar. The conclusions stated below are based upon the examination of 277 crania, and their description occupies 175 pages:

1. In the lower races the third molar is lacking less frequently than in the higher races, in the proportion of 19.86 per cent. of the former to 42.42 per cent. in the second.

2. The atrophy of the third molar is indeed less frequent in the higher than in the lower, the proportion being 10.90 per cent. of the former to 20.58 of the latter.

3. Ectopia is also a fact observable in all skulls of whatever race, 2.01 per cent. for the higher and 1.80 per cent. for the lower.

4. The same may be said of premature disappearance, 7.22 for the lower races, 7.58 for the higher.

5. Summing up all the cases of abnormality, including those in which there is an absence of the tooth, we find that in the lower races there is about an equal number of abnormal and normal, 50.54 normal, 49.46 abnormal; while in the higher races the abnormality is the rule and the normality the exception, 37.09 normal, 62.91 abnormal.

6. The ancient skulls, as regards the deficiency of the third molar, stand between the lower and higher of modern races. The absence amounts to 27.34 in the hundred, and atrophy to 16.41. On the other hand the premature disappearance is less frequent than in the modern skulls.

7. As to the number of roots in the third molar, there is no relation to the theory of evolution, the teeth examined belonging to lower as well as higher races. It is not true that in individuals of the highest race the number of roots is limited to one or two, while in the lower races the wisdom teeth always have three roots. Indeed the more common fact is this, that in ancient races as well as in the modern, higher or lower, we find the third molar with three roots to be 51.35 per cent. in modern higher races, 45.20 in modern lower races, and 46.43 in the ancient crania.

8. Teeth with four roots are more frequent in the skulls of modern higher races (5.24), after them the modern lower (3.20), and lastly the ancient (2.68). The occurrence of two roots is more frequent in the modern high (23.14), the next in the ancient

(20.53), and in nearly the same proportion is the modern low (20.09).

9. The occurrence of one root is more frequent in the lower modern (31.51), then in the ancient (30.36), and least in the modern high (20.10).

10. I have been able to find in one of the modern higher skulls a rare case—a tooth with five roots.

11. In the lower jaw of all races the third molar nearly always has two roots—91.84 in the modern low, 81.53 in the modern high, and 81.84 in the ancient.

12. I have not found in the modern low, nor in the ancient, a case of a lower third molar with four roots, whilst in the higher it stands 0.597.

13. The occurrence of only one root in the lower third molar is by no means rare, and is found more frequently in the ancient skulls (12.35), less frequently in the modern high (9.38), and most rarely in the modern low (6.12).

14. Cases of the lower third molar having three roots are not lacking, and are more frequently met with in the modern high (8.50), then in the ancient (6.17), and least in the modern low (2.54).

15. That there is witnessed in some cases a lack of one or more of the third molars is an ethnic fact.

16. The dogmatical assertions of Owen upon the number of roots in the negro races and the whites are therefore false, and the morphology of the roots of the third molar has no appreciable connection with evolution.

A remarkable addition to ethnological literature is a revision of Sir Gardiner Wilkinson's "Manners and Customs of the Ancient Egyptians," by Dr. Samuel Birch, and published by Murray, London.

GEOLOGY AND PALÆONTOLOGY.

EXTINCT MAMMALIA OF OREGON.—A list of *Mammalia* from the Miocene of Oregon was published in the December number of the NATURALIST, p. 833. Since that time, Prof. Cope has determined the characters of a number of additional species, some of which are new to science. Two of them belong to a new genus of *Carnivora*, whose cranial form is that of *Putorius* or *Lutra*, and which unites the premolar formula $\frac{3}{3}$ with the two superior tuberculars of *Canis*. It is called *Enhydrocyon*, with two species, *E. stenocephalus* and *E. basilatus*. A remarkable primitive type of *Artiodactyla* combining characters of Ruminants and Suillines with only two metacarpal bones in each foot, is named *Boöcharus*. The only species, *B. humerosus*, is as large as the Indian rhinoceros. A new ruminant is *Poëbrotherium sternbergii*. From the Loup Fork beds are *Lutrictis? lycopotamicus*, and a new species of *Protolabis*, which is named *P. transmontanus*. The article appears in the current number of the Bulletin of the Hayden Survey.

THE NECKS OF THE SAUROPTERYGIA.—It is known that the length of the neck in the Plesiosauroid reptiles of North America diminished in length as the group approached the period of extinction. Thus the longest necks in the order, those of the species of *Elasmosaurus*, are seen in the Niobrara (No. 3) division of the cretaceous. In the Pierre formation (No. 4), we find the shorter-necked *Elasmosauri*, and the *Cimoliasauri* with still shorter necks. In the latest cretaceous (Fox Hills or No. 5), the neck is reduced to its most abbreviated proportions, in the genus *Uronautes*. This shortening of the neck is thus associated with the shallowing of the water, which, as we know, gradually succeeded the deep-sea period of the Niobrara. In Europe the history of the order during the Jurassic period was the same. During the deep-sea epoch of the Lias we have the typical *Plesiosauri* represented by the long-necked *P. dolichodirus;* the shallower Oxford and Kimmeridge seas were the range of the shorter-necked *Muræosaurus;* while *Pliosaurus*, with the shortest neck, was cotemporary with these, and remained as late as the Portland. It is true, that long-necked forms continued as late as the Kimmeridge in England (*Colymbosaurus*). It has yet to be ascertained whether the European cretaceous Sauropterygia present the succession seen in those of North America.—*E. D. Cope.*

THE SCALES OF LIODON.—Professor Snow, of Lawrence, Kansas, has recently observed the scales of the abdominal surface of *Liodon dyspelor*. He states them to be smaller than those of the rattlesnake. Prof. Snow has also obtained a complete fore-limb of this species, and gives a figure of it in the Kansas City *Review of Science and Industry*.

THE FOSSIL INSECTS OF THE GREEN RIVER SHALES.—Mr. S. H. Scudder gives a series of descriptions of the insects obtained from the shales near Green River City, Wyoming, in the 4th volume of the *Bulletin* of the Hayden Survey. They represent the orders as follows: *Hymenoptera*, 4 sp.; *Diptera*, 14; *Coleoptera*, 37; *Hemiptera*, 12; *Orthoptera*, 2; *Neuroptera*, 2; total, 71. Then there are a few species of *Myriapoda* and *Arachnida*. Two new generic types of *Diptera* and one of *Hemiptera* are described.

GEOGRAPHY AND TRAVELS.[1]

THE SWEDISH ARCTIC EXPEDITION.—In the year 1556 Burrough discovered the strait leading into the Kara Sea, between Novaya Zemlya and the island of Waigatz; and in 1580 Pett sailed through the channel which separates Waigatz from the mainland, into the sea, where his further progress was barred by the ice. In 1595 the famous Dutch explorer, Willem Barentz, also reached the entrance to the sea. During the last century the Russians made several attempts to cross the sea, and in 1738 expeditions reached

[1] Edited by ELLIS H. YARNALL, Philadelphia.

the mouths of the Obi, Yenisei, and Pyasina rivers. In 1869 the Norwegian Captains Carlsen and Palliser sailed through the sea of Kara, and since that year the Norwegian fishermen have annually visited it in their pursuit of the seal and the walrus. In 1874 Captain Wiggins sailed from Dundee, and passing through the Waigatz straits, cruised along the Yalmal peninsula, and was able to advance as far as the gulf of Obi. On another voyage, in 1876, reaching the mouth of the Yenisei, he sailed up that stream as far as Kureika, where he left his vessel for the winter and returned overland. His observations demonstrated that the Gulf Stream flows into this sea. While, in July and August, in the same latitudes in Davis' straits and east Greenland, the surface-water is never above 33° to 34°, in the straits of Waigatz the temperature was as high as 50°, and from 48° to 49° in the sea of Kara.[1]

The knowledge thus obtained of the navigability, at certain seasons, of these waters, induced some wealthy Norwegians and Russian merchants to endeavor to open up a route to the mouths of the great rivers Obi and Yenisei, which penetrate some 2,500 miles into the heart of Siberia, and thus provide a new outlet for the mineral wealth of the Ural mountains, the fur and fish of the northern and the produce of the immense forests and agricultural districts of central and southern Siberia.

Mr. Oscar Dickson, of Gothenburg, a munificent and intelligent promoter of Arctic discovery, accordingly fitted out an expedition which sailed from Tromsö in June, 1875, under the command of Prof. Nordenskiöld. This gentleman was already a veteran explorer, having been engaged in six Arctic expeditions (five to Spitzbergen and one to Greenland), made two important spring sledging journeys, and experienced the rigors of a winter north of the 80th parallel, while his scientific attainments were of the highest order. Passing through the Yugor strait and crossing the sea of Kara, he reached a point on the eastern side of the mouth of the Yenisei, which was named Dickson Harbor, from whence he returned homewards.

In 1876 Mr. Dickson, aided by M. Alexander Sibeirakoff, a wealthy Russian, again dispatched Nordenskiöld, who, leaving Tromsö on the 25th of July, after some delays by the ice, again reached the mouth of the Yenisei, and ascended it to Mesenkin, from whence he returned, arriving at Tromsö on the 22d of September.[2]

The success of these two voyages induced Prof. Nordenskiöld to plan his present expedition round Cape Chelyuskin, along the Siberian coast to the straits of Behring. He believed that during September he would find open water all along the coast to Cape Chelyuskin. The rivers Obi, Irtish, and Yenisei send a vast vol-

[1] See *Geographical Magazine*, March, 1877.
[2] Petermann's *Mittheilungen*, 1877, Part II., p. 54.

ume of warm water into the ocean in the month of August, which would, from the effect of the rotation of the earth exercised on streams running north or south in high latitudes, be driven to the eastward, and open a channel along the coast.

Heretofore no vessel has succeeded in doubling Cape Chelyuskin. Between the years 1735 and 1740, the expeditions sent out by the Russian government surveyed portions of the coast, and their vessels reached the mouths of the Pyasina on the west, and of the Khatanga on the east side of Cape Chelyuskin; but it was not until 1742 that Mate Chelyuskin discovered the northernmost point of Asia when on a sledge journey. From the Lena to Behring's straits more is known of the coast, but the expeditions were made in small sailing vessels, and passed over, in most cases, but small portions of the coast line. In 1728 Behring visited the straits now called after him; in 1770 the New Siberian islands were discovered; and in 1778 Captain Cook reached the 180th degree of longitude. Our best accounts of this region are derived from the explorations of the Russian Admirals Wrangell and Anjou, in 1820, '21, '22, and '23. Kellett Land and Herald island were discovered by the British in 1849, and in 1855 the United States expedition under Captain, now Admiral, Rodgers, reached the 176th degree of longitude. In 1867 Captain Long, in an American whaling vessel, got as far as 170° E.

At present, says the *Geographical Magazine*, August, 1878, we have no knowledge of the vegetable and animal life (consisting of survivals from the glacial period) in the sea which washes the north coast of Siberia, yet a complete and certain knowledge of what animal types are of glacial and what of Atlantic origin, is of the greatest importance, not only for zoölogy and for a knowledge of the geographical distribution of animals, but also as regards the geology of Scandinavia. Our knowledge of the animal and vegetable types which lived at the same time with the mammoth is exceedingly incomplete.[1]

Influenced by all these considerations, the Swedish government and the King and M. Sibeirakoff together contributed £8,000, to which Mr. Dickson added £12,000, to fit out the present expedition. The *Vega*, a very strong steamer of 300 tons, was purchased, and supplied with from two to three years' provisions, coal sufficient to steam 8,000 nautical miles, and a steam launch. The names of the officers of the *Vega* are: Prof. Nordenskiöld; Captain Pallander, commander (who has had much experience in Arctic voyages); Doctors Kjellmann, Stuxberg, and Almgvist, Scientific staff; Lieut. Hovgaard, Danish Navy; Lieut. Brusevitz, Swedish Navy; Lieut. Bove, Italian Navy; and Lieut. Nordgvist, a Finnish officer and geologist. The crew consists of eighteen seamen and three hunters.

The *Vega* departed from Tromsö July 21, 1878, and arrived at

[1] See also Petermann's *Mittheilungen*, 1878, Part 2, p. 67.

Habarowa, a Russian hunting-place in the Yugor straits, on the 30th. She was accompanied by a small steamer, the *Lena*, and also by the steamer *Fraser*, having a sailing vessel, the *Express*, all employed by M. Sibeirakoff, to open maritime commerce with Siberia. During their short stay here collections were made of the fauna of the sea and the flora of the land. Many specimens of fish were obtained, and special attention devoted to the morphology and development of the phænogamous plants. Habarowa is inhabited in the summer by nine Russians, who live in wooden, turf-covered cabins, while the native Samœides have tents of reindeer skin. Dr. Nordenskiöld purchased some of the native costumes, and, after some difficulty, specimens of their "gods." These objects of veneration resemble the rude rag dolls of children, and are of stone or wood, dressed in fur and fine rags, with pearl ornaments. Sacrifices of bears, reindeers, etc., are made.

The island of Waigatz is a plateau about 90 kilometres long by 40 broad. The Silurian and limestone beds contain many fossils. Leaving Habarowa on the first of August, the *Vega* sailed slowly (to allow time for dredging) across the Karian sea, while the *Lena* was sent to examine the Beli strait, which separates White island from the Yalmal peninsula. Some fields of rotten ice were encountered but fog proved the only hindrance, and they reached Dickson Harbor on the 6th of August. Prof. Nordenskiöld speaks of this harbor as safe and commodious, and as promising to become the chief port for the export of Siberian products. In geological formation, the land resembles Spitzbergen. In consequence of the inferior saltness of the water, there is little animal life. Three white bears were shot.[1]

After a careful survey of Dickson Harbor, and adding to her supplies the coal and provisions brought so far by the *Express*, the *Vega*, still accompanied by the *Lena*, continued her voyage on the 10th. Further information of the expedition is given in a letter of Prof. Nordenskiöld's in the *New York Herald*, and in accounts in various European journals. On the 11th of August they passed Cape Sterlegoff, the furthest point ever reached by a vessel. They soon perceived the charts to be entirely wrong, the coast being far more to the west than supposed, and numerous islands not given were met. The fog caused much embarrassment, but the ice did not often give them much trouble. The saltness of the water increased and the temperature fell, while the organic life at the sea-bottom became richer, and fine specimens of the remarkable crinoid *Alecto eschrichtii*, starfish, and large ocean Algæ were obtained. On shore the higher fauna and flora were very poor. Snow sparrows, several species of wading birds, and some varieties of geese were found. Occasionally scenes of great beauty were presented when the sea was smooth and clear; the

[1] See Prof. Nordenskiöld's letter from Dickson's Harbor in Petermann's *Mittheilungen*, 1878, Part xi, p. 430. Also letter of Lieut. Hovgaard's, from same place, in *Verhandlungen der Gesellschaft für Erdkunde zu Berlin*, 1878, p. 198.

midnight sun hung low over the horizon, and to the south the Taimyr land glittered fiery red in its rays, while the cliffs and castles of ice stood colored blue, purple, crimson, and silver-white. Over this scene lay a stillness which sent a man's voice miles and miles away, and the scratch of the bears walking over the ice-blocks was heard afar off. Waiting for clear weather, they lay at anchor, from the 14th to the 18th, in a small bay in the sound between the island of Taimyr and the continent. This haven was named Actinia Port, and would be a favorable position for one of Weyprecht's proposed meteorological stations. The land here was free from snow, and covered with a gray-green carpet of grass, mosses, and lichens. On the 18th, the fog still continuing, they set sail, and in spite of fog and some large masses of ice, passed Cape Chelyuskin on the 19th, with flags waving and guns firing a salute. Cape Chelyuskin is a low promontory, divided into two parts by the bay in which the vessels anchored. The west cape is in 77° 36′ 37″ N. lat. and 103° 25′ 5″ E. long., and the east cape is in N. lat. 77° 41′ and E. long. 104° 1′. Inland the coast gradually rises to about 1,000 feet. This hill, as well as the lowland, was almost free from ice. The ground appeared to be mainly clay, curiously cracked, and covered with moss, lichens, etc. The formation here were perpendicular strata of slate, with no fossils, but rich in crystals of sulphide of iron, and at one point traversed by large veins of quartz. Both animal and vegetable life were exceedingly poor and the former very tame. In the sea also the higher forms of life were scarce, but large Algæ and a large number of lower animals were obtained. On the 20th they weighed anchor, when drift ice was soon met with. After being obliged to sail in a northern and north-western direction they escaped, and the north-eastern extremity of the Taimyr peninsula (76° 30′ N. lat. and about 113° E. long.) was sighted. The coast is about fifty miles more to the west than noted on the charts. Here they found almost open water. It was observed that the bergs encountered were of fresh-water formation, indicating the existence of hilly islands to the north. Mountains of 2,000 to 3,000 feet in height were seen some distance away from the coast. There was now a great increase in marine animal life, all of pure arctic types. The island of Preobashenskoi was reached on the 24th, and found to have been laid down sixty miles too far west. From here eastward to the Lena an ice-free and comparatively warm sea was met with.

Arriving at the mouth of the Lena the two vessels parted company, and the *Vega* continued on her way, while the *Lena* ascended the river to Yakutsk, arriving there on the 21st of September.

As no further account of the former has been received, she is no doubt passing the winter in the ice, perhaps near the East cape, where Captain Campbell, of the steamer *Norman*, from

St. Lawrence bay, October 20, 1878, reports that the natives have seen a vessel.

So far this has been one of the most successful and important of modern exploring voyages. The chart of the voyage is published in the *Mittheilungen* for January, and is of great interest to geographers, as so many corrections have been made in the coast-line of the northern shores of Asia.

The discovery by the Norwegian Captain E. Johannsen, of a small island in long. 81° E. and lat. 77° 55′ N., was made on the 3d of September last. He named it "*Ensomhaaen*" (Loneliness). The sea was open in every direction round it except to the south-east, where drift-ice was to be seen.

Already commerce has sprung up on the new route, and during the last season vessels were sent out from English, German, and Norwegian ports, and made more or less successful voyages to the Ob and Yenisei and back.

MICROSCOPY.[1]

NUCLEATED RED CORPUSCLES OF HUMAN BLOOD.—Many of the readers of the AMERICAN NATURALIST are familiar with the little instrument generally known as Beck's Vertical Illuminator, it is in fact a modification of a device invented by Prof. H. L. Smith, of Geneva, N. Y.

This illuminator was originally intended to be used in conjunction with medium power, dry objectives, of moderate angles, such as were formerly so much in vogue. Mr. Morehouse, a well known microscopist of Wayland, New York, fortunately discovered that by the conjoint use of the illuminator with immersion objectives of high balsam apertures, astonishing results might be secured, as for instance the resolution of the markings of podura and other insect scales, the striation of valves of *Frustulia saxonica*, *Surirella gemma* and similar "difficult" diatoms, under amplifications of 3000 and 4000 diameters, and as a matter of course, by reflected light.

Mr. Morehouse promptly informed me of his results, and I immediately repeated his experiments, and with perfect success; I also devised a modification, consisting of an adjustable shutter, regulating the admission of light, thus greatly improving the brilliancy of the objects, accompanied with marked increase of resolving power, and with the instrument thus modified I had no difficulty in obtaining beautiful displays of the Nobert 19th band, the simultaneous exhibition of the long and transverse striæ of *Frustulia saxonica*, etc., under powers of three and four thousand diameters.

Desiring to test the vertical illuminator over histological preparations, I thus examined a slide of human blood, improvised for the occasion, and was astonished to find about three-fourths of

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

the red corpuscles nucleated, the amplification employed in these observations was about 3700 diameters.

My observations with the vertical illuminator as above related, were presented to the Dunkirk Microscopical Society in a paper which I had the honor to read before that society some two years ago, on which occasion many of the observations were publicly repeated, since which date similar results, as to the nucleus of the red corpuscles, have been arrived at by others, but as far as I can learn, these later observers subject the blood to treatment by means of re-agents, etc., the direct observations, therefore, as obtained with the vertical illuminator are to be preferred.

A point which should not be lost sight of is this, the vertical illuminator can only be successfully used in conjunction with an objective of high balsam angle; and may it not be further suggested that the use of wide angled glasses is not to be confined to the work of the diatomist?—*J. Edwards Smith, M.D., Cleveland, Ohio, Dec.*, 1878.

The Wenham Compressorium. — Mr. Geo. O. Mitchell, of Hanover, N. H., is making this useful little accessory of a somewhat smaller size than usual, and at a less price. His instruments have been furnished to several colleges and to experienced workers with the microscope. They are well made, and are sent by mail for $1.50, or nickel-plated for $1.75.

Exchanges. — Frank S. Collins, 26 Tremont street, Boston, Mass, would like to exchange New England for California, Florida and other Algæ.

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SCIENTIFIC NEWS.

— Dr. Albert Günther, director of the zoölogical department of the British Museum, has received the gold medal of the Royal Society for his important researches on the zoölogy and anatomy of the fishes and reptiles.

— The *Polytechnic Review* of Dec. 21, states that "Prof. J. Gibbons Hunt, of New York, one of the most accomplished microscopists in the country, says that it is affectation or stupidity for Americans to send to Europe for microscopes when they can now purchase better ones at home." It will surprise Dr. Hunt's friends to learn that he is "of New York," especially since the editor of the "*Review*" is, like Dr. Hunt, a citizen of Philadelphia.

— We learn that the Princeton Geological and Palæontological party met with excellent success during the past season. They visited the region of the Mammoth Buttes, east of the Green river, in southern Wyoming, which was explored by Prof. Cope in 1872, and obtained fine series of *Loxolophodon cornutus, Palæosyops vallidens* and other species. They will be able to furnish much additional information as to the structure of these

animals. They also examined the region of the upper Ham's Fork, and visited the fish-bearing shales of the tributaries of Bear river, obtaining a good representation of the fossils of that region.

— Longmans & Co. have just published a translation of Heer's The Primæval World of Switzerland. Edited by James Heywood. An excellent book for boys with a love of insects is Candèze's The Curious Adventures of a Field Cricket. The illustrations and style are most inviting. Dr. Ernest Candèze has long been known as a Belgian coleopterist of high reputation. Petermann's Mittheilungen, will hereafter be edited by Dr. E. Behm, assisted by Dr. Lindeman.

— Etna: a history of the mountain and of its eruptions, by G. F. Rodnell; with maps and illustrations, London (C. Kegan Paul & Co.), is said to be an excellent and most interesting monograph, comparing favorably with Prof. Phillips' work on Vesuvius.

— The death of George Henry Lewes was quite as much a loss to biology as it was to literature and philosophy. His Seaside Studies is one of the most readable of such books, and in literary merit far out-weighs any similar works; besides it is critical from the point of view of comparative anatomy and physiology. What a hold the biological methods of inquiry have gained among philosophic thinkers is evinced by the reception accorded to Lewes' last and greatest work, the Problems of Life and Mind, however much one may refuse to endorse all the conclusions of its author.

— A new edition of Prof. Ramsay's Physical Geology and Geography of Great Britain is occupying the attention of reviewers in British journals. His American friends will be pained to know that late in the autumn Prof. Ramsay suffered the extirpation of an eye.

— Prof. Tyndall has just communicated to the Royal Society the results of some further observations on infusions boiled in flasks afterwards hermetically sealed. He took with him to the Alps, last summer, one hundred tubes of infusions—fifty containing turnip and fifty containing cucumber infusions. They were prepared at the laboratory of the Royal Institution, and boiled for five minutes. Twenty flasks were broken in transit. The eighty remained pellucid, and the twenty were turbid with organisms. A number of the eighty flasks had their ends opened in air in which saw-dust had been shaken up, and all were soon turbid. Another set were infected by water of a cascade derived from melting snow, and in three days were thickly charged with organisms. Another set were opened in pure air and remained transparent.

— The curious discovery, says the *English Mechanic*, of parasitism on a diatom (*Pinnularia*) has recently been made by a

Frenchman, who observed small brown points on the surface of the diatom, which have extraordinary agility, and by means of their long flexible appendices explore all parts of the frustule.

— Herr Naumann, a German geologist in Japan, has lately published a work on the earthquakes and volcanic eruptions of Japan. Mr. V. Ball publishes, in the *Geological Magazine* for January, an illustrated article on the volcanoes of the bay of Bengal, correcting some current errors in regard to them.

— We have had an opportunity of examining some excellent photographs by Mr. Franklin C. Hill, of Princeton, New Jersey, illustrating the external anatomy of *Harpalus caliginosus* and *Lucanus cervus*; they are about six inches long. Each appendage and joint, as well as the veins of the wings and the different parts of the body are labeled, so that they are excellent diagrams for the beginner in entomology. The upper and under side of the body is represented, there being four photographs in all, at fifty cents each.

— A writer in *Scribner's Monthly* refers to the protective coloration of the Caribou, stating that the quiet gray color is well adapted to conceal its presence from the hunter, and that it requires an educated eye to pick out its form on the heathy barren where everything assimilates to it in color. "The Indians are so well aware of this, that they always approach a barren with extreme caution, always traveling down wind, and never disconcerted if game is not sighted at once. Nor is the case improved when one comes to hunt for them in the forest; there, the gray tree-trunks and tangled undergrowth make it extremely difficult to see them."

— M. Charles Barrois, of Lille, France, the author of the elaborate treatise on sponges, which appeared two years since, is now in this country studying the geology of the United States east of the plains. Hereafter M. Barrois will devote himself to palæontology and geology, while his brother, M. J. Barrois, the author of the exquisite works on the embryology of nemertean worms and Polyzoa, will continue his zoölogical studies.

— We regret to notice the suspension of *Field and Forest*, edited by Charles R. Dodge. It was the bulletin of the Potomac-side Naturalists' Club. The number for April, May and June, only lately received, closes volume third, and contains an index.

— Mr. Xenos Clark, of San Francisco, writes us that he is endeavoring to establish a Biological Laboratory at or near that city. Such an institution would be most desirable, and it is to be hoped will meet with liberal support.

— The museum of Brown University has secured through the generosity of the Senior Class of 1878, the skin of a Baffin's Bay walrus, which has been admirably mounted by Professor Jenks, and is now on exhibition.